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North Carolina Department of Transportation
Division of Highways
Statewide Planning Branch

KNIGHTDALE THOROUGHFARE PLAN TECHNICAL REPORT

NOVEMBER, 1994

KNIGHTDALE
THOROUGHFARE PLAN

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Prepared by:
Statewide Planning Branch
Division of Highways
North Carolina Department of Transportation

In cooperation with:
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Wake County
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TECHNICAL WORDS AND PHRASES

ADT - **A**verage **d**aily **t**raffic.

Capacity - The formal definition of capacity is given on page 23. Maximum capacity occurs at LOS E.

CBD - **C**entral **b**usiness **d**istrict. This is the heart of a downtown area.

Dwelling Unit - A dwelling unit is a place where one can live. Examples of a single dwelling unit include: a single family house, one hotel room, one apartment in an apartment building, or one half of a duplex.

DU - **D**welling **u**nit.

Level of Service - The relationship of traffic volumes to the capacity of the roadway will determine the level of service. It is a rating system for such a relationship, similar to a report card. The table on page 24 defines the various levels of service A through F.

LOS - **L**evel **o**f **S**ervice

NCDOT - **N**orth **C**arolina **D**epartment **o**f **T**ransportation

Practical Capacity - This is the capacity at a LOS D.

TIP - **T**ransportation **I**mprovement **P**rogram. A document produced yearly by the NCDOT which reflects the spending schedule for Transportation projects.

vpd - **v**ehicles **p**er **d**ay

TECHNICAL TERMS AND ACRONYMS

ADT - Average daily traffic

Capacity - The formal definition of capacity is given in Appendix B. Maximum capacity occurs at LOS E.

CBD - Central business district. This is the heart of a downtown area.

Dwelling Unit - A dwelling unit is a place where one can live. Examples of a single dwelling unit include: a single family house, one hotel room, one apartment in an apartment building, or one half of a duplex.

DU - Dwelling unit

Level of Service - The relationship of traffic volumes to the capacity of the roadway with respect to level of service. It is a rating system for which a letter grade is assigned, like a report card. The scale of grades used to define the various levels of service is given in Appendix B.

LOS - Level of Service

NCDOT - North Carolina Department of Transportation

Practical Capacity - This is the capacity at LOS D.

TIP - Transportation Improvement Program. A document produced yearly by the NCDOT which details the spending schedule for Transportation projects.

vpd - vehicles per day

I. INTRODUCTION

Transportation system efficiency, today more than ever, plays a vital role in our economy and way of life. It is used every day by the business, industrial and residential sectors. To insure that individual road projects eventually form a cohesive, coordinated system, a **thoroughfare plan** is developed.

The purpose of this study was to re-examine the present and future transportation needs of the area, and from this derive a Thoroughfare Plan. The system of thoroughfares proposed was developed following the principles of thoroughfare planning outlined in Chapter II of this report. In May of 1986 the Knightdale Town Manager wrote to NCDOT to request that a Thoroughfare Plan be done for the Town of Knightdale. This study was started in 1986, with a design year of 2005. The Town and the State were unable to come to a mutually acceptable Plan, and the study was put on hold. The study was revived at the request of the Town of Knightdale in 1992. The Town formed a Thoroughfare Committee to review the issues and work with the State to arrive at a mutually adoptable Plan. This report documents both the earlier study and the mutually adopted Plan which came out of the revived study.

The recommended cross-sections are based on existing conditions and the expected volume of traffic in the design year. Before a project is implemented a more detailed evaluation will be performed. Every effort was made to use as much of the existing street system as possible in order to minimize cost and environmental disruption. Location of new facilities was based on field investigation, existing land use, and topographic conditions.

This Thoroughfare Plan is intended to prepare the Town of Knightdale for the expected high growth rate in the years ahead. The proposed plan includes the US 64 Bypass which runs south of Knightdale parallel to existing US 64. This facility will help relieve congestion on US 64 and provide a faster means of travel around the Knightdale area.

Initiative for plan implementation will rest largely with the policy boards and citizens of the area. The scope of highway needs throughout the State greatly outweigh the available funding. It is, therefore, necessary that the local area aggressively pursue funding for desired projects.

Responsibility for the proposed construction must be shared by Knightdale and the N. C. Division of Highways. With the different governmental agencies involved in providing the elements of the plan, coordination of activities is of prime importance. The plan is formally adopted by both the local governing bodies and the North Carolina Board of Transportation, to serve as a mutual official guide in providing a well coordinated, adequate, and economical major street system. In order for the plan to be effective, the Town, County and the State must procure in advance or protect by various legal controls the right-of-ways necessary for the improvements which will ultimately be required.

It must be emphasized that the Thoroughfare Plan was based on anticipated growth of the urban area, as provided by the Town of Knightdale and Wake County. Actual growth rates and patterns may differ from those anticipated and it may become necessary to accelerate or retard the development of thoroughfares or to make revisions in the proposed plan. It is desirable to review the plan in detail approximately every ten years to adjust the thoroughfare system to the actual rate and type of development.

II THOROUGHFARE PLANNING

Basic Principles

The urban street system typically occupies 25 to 30 percent of the total developed land in the urban area. Since the system is permanent and expensive to build and maintain, much care and foresight are needed in its development. Thoroughfare planning is the process used by public officials to assure the development of the most logical and appropriate street system to meet future travel desires. The major steps involved in the thoroughfare planning process are:

1. *Collection of data* concerning existing physical development and travel desires within the area.
2. *Prediction of future data.*
3. *Evaluation* of the adequacy of the existing street system in serving present and future travel.
4. *Formulation of the best thoroughfare plan*, on the basis of travel demand, economic benefits, and environmental considerations, to meet future travel desires.
5. *Development of construction priorities* for plan implementation.
6. *Implementation* of the plan.

Purpose of Planning

There are many benefits to be gained from thoroughfare planning, but the primary objective is to assure that the street system will be progressively developed in such a manner as to adequately serve future travel desires. Thus, the cardinal concept of thoroughfare planning is that provisions be made for street and highway improvements so that as needs arise, feasible opportunities to make improvements exist.

Some of the benefits derived from thoroughfare planning are: (1) Each street can be designed to perform a specific function. This permits savings in right-of-way and construction costs, and encourages stability in travel and land use patterns. (2) Local officials and citizens are informed as to future improvements. Public facilities can be better located, and damage to property and appearance can be minimized (for example: buildings and plants can be located to permit future street widening). (3) Residents will know which streets will be developed as major thoroughfares and be able to make an informed decision when choosing a home. (4) City officials will know when improvements will be needed and can schedule funds accordingly.

Efficiency

The improvement of the efficiency of existing facilities can be achieved through: (1) improving the **system efficiency**; and (2) improving the **operational efficiency** of thoroughfares.

(1) System Efficiency - A more efficient system can reduce travel distances, time, and cost. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

Functional Classification - Streets perform two primary functions - they provide **traffic service** and **land service**. *These two functions are basically incompatible.* The conflict is not serious if both traffic and land service demands are low, but when traffic volumes are high, conflicts created by intense land service demands result in intolerable congestion.

The Thoroughfare Plan provides a functional system of streets which permits travel with directness, ease, and safety. Different streets in the system are designed to perform specific functions thus minimizing the traffic and land service conflict. Streets can be functionally categorized as: local access streets, minor thoroughfares or as major thoroughfares.

"Local Access Streets" provide access to abutting property. They are not intended to carry heavy volumes of traffic and should be located such that only traffic with origins or destinations on the streets would be served. *THEIR FUNCTION IS TO PROVIDE ACCESS.* Depending upon the type of land use which they serve, local access streets may be further classified as residential, commercial, and/or industrial.

"Minor Thoroughfares" are more important streets in the city system. They collect traffic from local access streets and carry it to the major thoroughfare system. They may, in some instances, supplement the major thoroughfare system by aiding minor through movements. A third function which may be performed is that of providing access to abutting property. They should be designed to serve limited areas so that their development as major thoroughfares will be prevented.

"Major Thoroughfares" are the primary traffic arteries of the town. Their function is to move intra-city and inter-city traffic. Although undesirable, the streets which comprise the major thoroughfare system may also serve abutting property; however, *THEIR MAJOR FUNCTION IS TO CARRY TRAFFIC.* They should not be bordered by strip development because such development significantly lowers the capacity of the thoroughfare, and each driveway is a danger to traffic flow. Major thoroughfares may range from two lane streets to expressways with six or more traffic lanes. As a general rule, parking should not be permitted on major thoroughfares.

(2) Operational Efficiency - A street's operational efficiency is improved by increasing the capability of the street to carry vehicular traffic and people. In terms of vehicular traffic, a street's **capacity** is defined as "the maximum number of vehicles which can pass a given point on a roadway during a given time period under prevailing roadway and traffic conditions." Capacity is affected by the physical features of the roadway, the nature of the traffic, and the weather.

Physical ways to improve vehicular capacity include street widening, intersection improvements, improving the vertical and horizontal alignment, eliminating road-side parking and eliminating property access points.

Operational ways to improve street capacity include:

(1) **Control of access** - A roadway with complete access control can carry over two times the traffic handled by a non-controlled access street.

(2) **Parking removal** - Increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking operations.

(3) **One-way operation** - The capacity of a street can be increased by as much as 50%, depending upon turning movements and overall street width, by initiating one-way traffic operations. One-way streets can also improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.

(4) **Reversible lanes** - Reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods.

(5) **Signal phasing and coordination** - Uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

(1) Encourage people to form carpools and vanpools for work and other trips. This reduces the number of vehicles on the roadway while increasing the people carrying capability of the street system.

(2) Encourage the use of mass transit, bicycles, and pedestrian travel.

(3) Encourage industries and business to stagger work hours or establish variable work hours for employees. This will reduce travel demand in peak periods and spread peak travel over a longer time period.

Idealized Thoroughfare System

The major thoroughfares can be considered as a coordinated system thoroughfares, forming the basic framework of the urban street system. A major thoroughfare system which is most adaptable to desire lines of travel within an urban area and which permits movement between various areas of the town with maximum directness is the radial/loop system. The thoroughfare system consists of the following elements:

Radial Streets - provide for traffic movement between points located in the outskirts of the town and the central area. This is a major traffic movement in most cities. The economic strength of a central business district depends upon the adequacy of this type of thoroughfare. Examples of radial streets would include Smithfield, Bethlehem and Old Knight Roads.

Circumferential or loop system streets - move traffic between suburban areas of the town. Although a loop may completely encircle the town, a typical trip may be form an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets do not necessarily carry heavy volumes of traffic (although they may), but they function to help relieve central areas. The Forestville/Faison Road facility is a partial loop system.

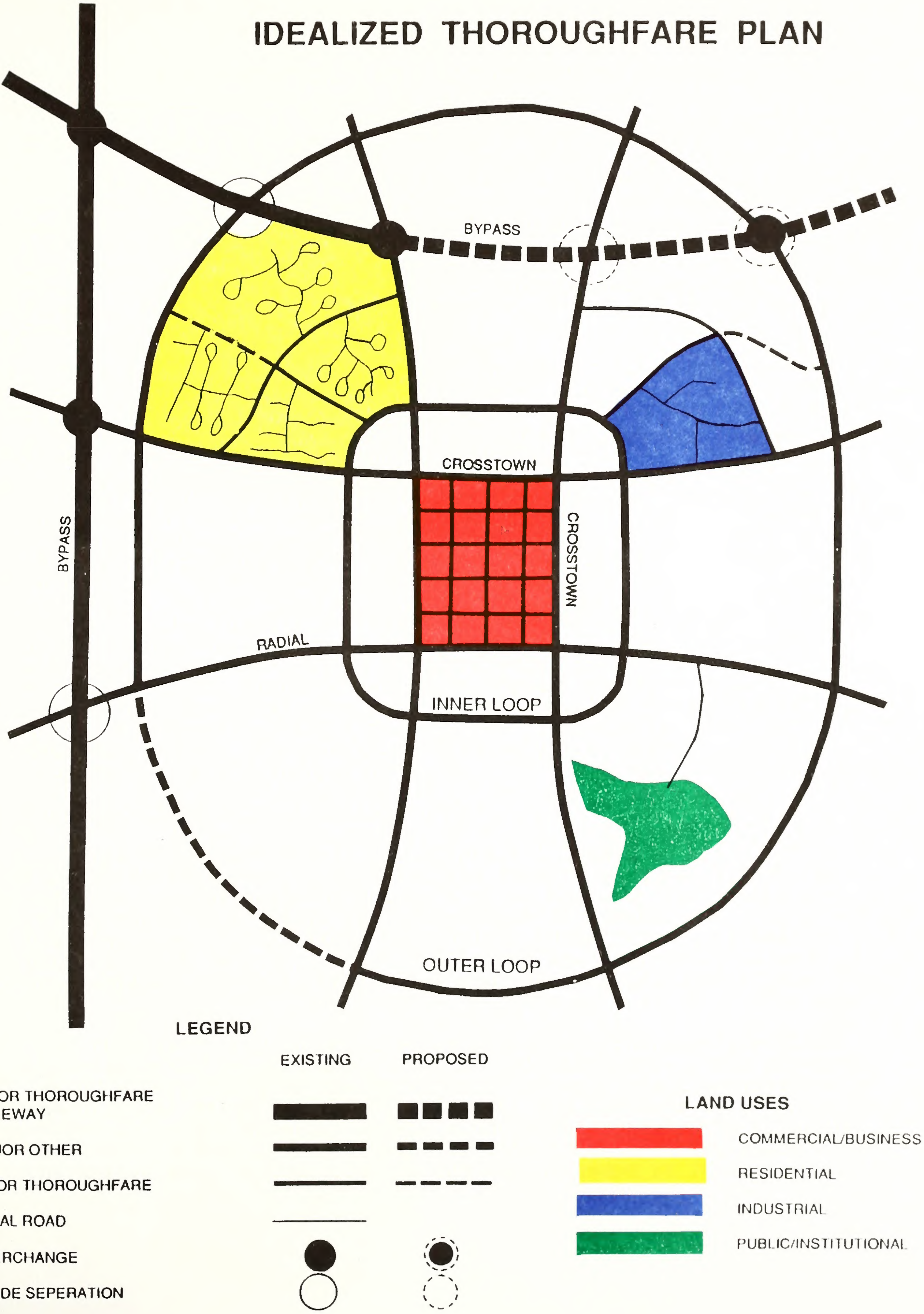
A **Bypass** is designed to carry traffic through or around the urban area, thus providing relief to the town street system by removing from it traffic which has no desire to be in the town. Bypasses are usually designed to highway standards, with control of access. Bypasses may also serve as a portion of an urban loop. By freeing the local streets for use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area.

Figure 1 shows the Idealized Thoroughfare System. This system is augmented by local residential, commercial and industrial streets.

Application of Thoroughfare Planning Principles

The above descriptions are of an idealized major thoroughfare system. In actual practice, thoroughfare planning is done for established areas and is constrained by existing land use and street patterns, public attitudes, and expectations of future land use. Compromises must be made because of these, and other factors that may affect major street locations.

IDEALIZED THOROUGHFARE PLAN



III EXISTING AND PROJECTED CONDITIONS

The Planning Area - Past and Present

The Town of Knightdale is located in the eastern portion of Wake County, in central North Carolina, approximately eight miles east of Raleigh. Founded by H. H. Knight and incorporated in 1927, the Town has long been a home for farmers and owners of businesses in the area. More recently it has become a convenient place to live for people who work in Raleigh and the Research Triangle Park (RTP) due to the expanding growth of the Raleigh Area.

In addition to Raleigh, two other major cities are easily accessible from Knightdale. Rocky Mount, N.C. is located 45 miles to the east on US 64, and Wilson, N.C. is located 39 miles to the east on US 264. The towns of Wendell and Zebulon are located immediately to the east of Knightdale.

Knightdale is served by US 64 which runs east to west through the northern portion of the Town and by the Norfolk and Southern Railroad which runs east to west through the "Town center." There is no principal highway access to the Town from the north or the south.

Knightdale itself is fairly small, with the surrounding area largely undeveloped. The topography of the area is rather flat with few slopes over 5% and the only soils too steep for construction are along stream banks. These suitable natural conditions, along with its proximity to Raleigh and accessibility to US 64 (as well as the future US 64 Bypass and the Northern Wake Expressway) make the Knightdale area very attractive to prospective land developers.

Factors Affecting Transportation

The three most significant factors influencing the transportation needs of any area are its population, economy, and land use. Examination of these factions helps to explain historic travel patterns and lays the ground work for thoroughfare planning. Additional items may include the effects of legal controls such as subdivision regulations and zoning ordinances, availability of public utilities, and physical features of the area.

The first step in the development of the thoroughfare plan is to define the planning period and the planning area. The planning period is typically on the order of 20 years. The base year for the original Knightdale study was 1985, and the year 2005 was chosen to be the endpoint of the study period. When the study was revived, the data for 1990 was available to augment the study, and the design year of the study period was extended to 2010.

The planning area is generally the limits to which some urbanization is expected to occur during the planning period. The Planning Area consists of the Knightdale area and the surrounding portion of Wake County.

The potential land development of a planning area helps determine the location of new thoroughfares and the improvements to existing ones. Some of the factors influencing the development of an area are:

1) Economic Factors
   - Availability of investment capital
   - Market demand / proximity
   - Construction costs
   - Availability or costs of providing utilities and services
   - Transportation costs
   - Tax rates

2) Sociological Factors
   - Proximity to employment
   - Proximity to shopping areas
   - Proximity to schools, churches, etc.
   - Proximity to transportation facilities
   - Aesthetic qualities of area

3) Regulatory Factors
   - Zoning regulations
   - Subdivision ordinances
   - Environmental restrictions

4) Topography and other physical features of the area.

The relative importance of each factor depends on the type, size and location of the particular development in question. It is apparent that the nature of urban growth is quite complex.

In order to design an adequate Thoroughfare Plan, forecasts of future travel characteristics must be developed. Such forecasts are possible when the following major items are carefully analyzed:

1) historic and potential population changes;
2) motor vehicle registration and usage;
3) significant trends in the economy; and
4) character and intensity of land development.

GEOGRAPHIC LOCATION

KNIGHTDALE, NORTH CAROLINA

KNIGHTDALE IS LOCATED JUST OFF OF HIGHWAY US 64 IN WAKE COUNTY APPROXIMATELY 7.8 mi. EAST OF RALEIGH, NORTH CAROLINA

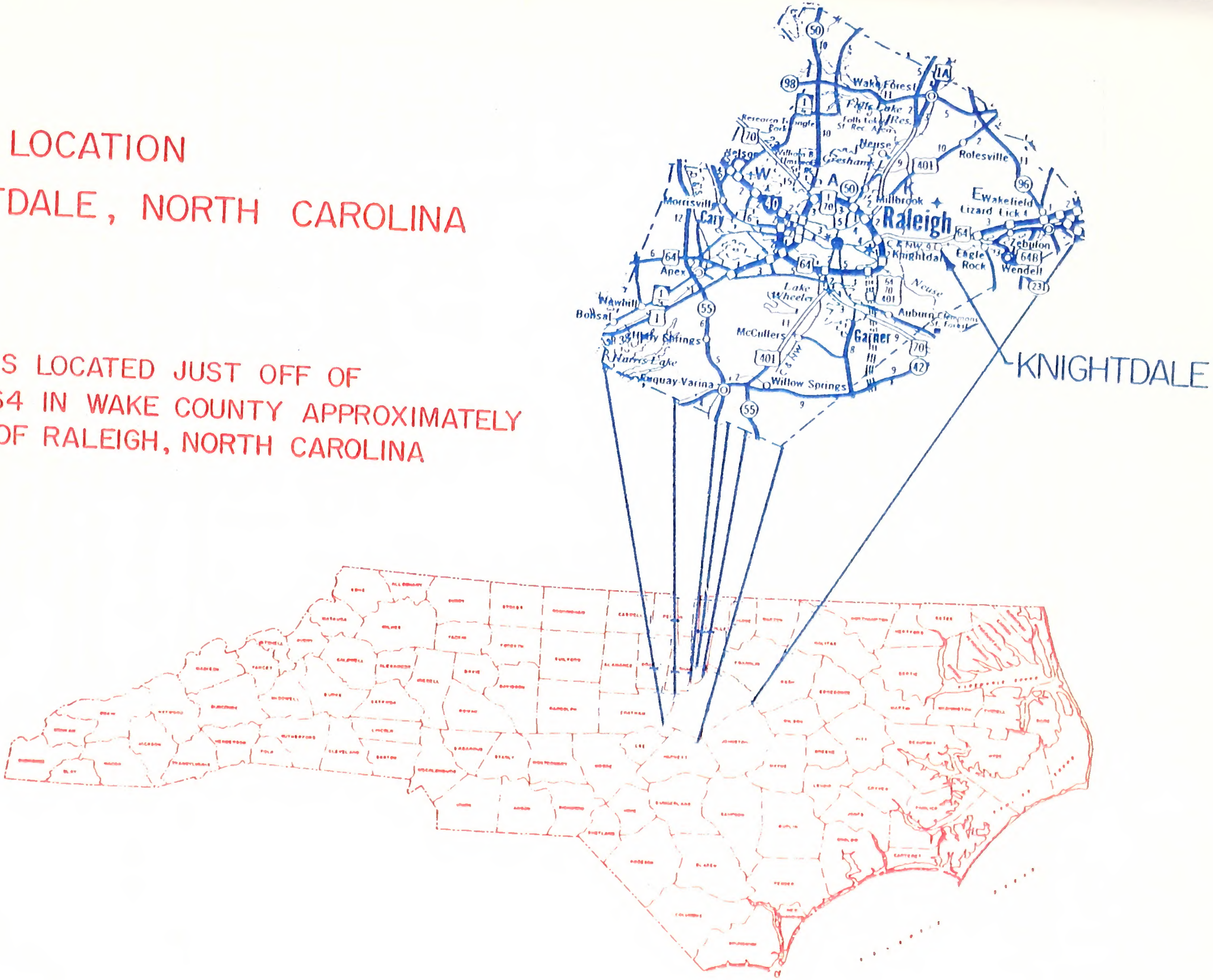


FIGURE (2)

Population Trends

Travel is directly related to population, and the volume of traffic is closely related to the size and distribution of the population which it serves. Observing and studying past population trends helps to determine future populations and their distribution, which in turn helps to predict future travel demands.

Population totals and trends for Knightdale, St. Matthews Township, Raleigh, Wake County and North Carolina are given in Table 1. Raleigh was included in the data because of its proximity to Knightdale. As the Raleigh area becomes more crowded due to increases in population, more and more people will be looking to the surrounding towns and cities for residency. This point is reflected in the population figures for Knightdale and Raleigh.

TABLE 1
POPULATION TRENDS

	North Carolina	Wake County	St. Matt. Township	Town of Knightdale	City of Raleigh
Year					
1970	5,082,059	228,453	9,920	815	121,577
1980	5,881,766	301,327	20,412	985	150,255
1990	6,632,448	426,301	26,976	1,884	212,092
1990					237,146^
2005	7,708,505*	615,182*	48,387@	7,749+	297,482^
2010	8,019,840*	677,905*	51,225@	9,201+	320,910^
% Growth					
1970/80	1.5	2.8	7.5	1.9	2.1
1980/90	1.2	1.4	2.8	6.7	3.5
1990/2010	1.0	2.3	3.3	8.3	1.5

% Growth is per year using simple interest formula $F=P(1+R)^N$

Sources: US Bureau of Census
* Office of State Budget and Management 1/1994
+ Town of Knightdale Planning Department 1/1994
(includes Western Annexation)
@ Wake County Planning Department 1/1994
^ Raleigh Planning Department for ETJ 1/1994

Vehicle Ownership Trends

As can be seen from Table 2, vehicle registration in Knightdale has grown steadily in the past. In the period from 1975 to 1985 the number of vehicles registered to the residents of

Knightdale has increased by 59%. This steady growth in vehicle registration reflects the growth and development of Knightdale in the past decade. The large increase of vehicles shows how quickly the Knightdale area is developing and supports expectations for future rapid growth in the area.

Figure 3 shows the person per vehicle trends for North Carolina and Wake County from 1940 through the design year. This graph was derived by dividing the total population by the total number of vehicles registered for the years shown. The results show a transition from a non-automobile oriented society to one which is heavily dependent on the automobile.

Since the early 1970's however, the idea of purchasing more automobiles has had less influence and, as such, led to the expectation that the persons per vehicle rate will begin to stabilize as projected in Figure 3. This saturation effect is expected to stabilize trip-making characteristics of families in the middle and upper income categories due to the fact that they already have the financial means to purchase a sufficient number of vehicles to satisfactorily serve their transportation needs. On the other hand, moderate growth in the trip-making characteristics of lower income families is predicted due to an expected improvement in their financial well-being.

TABLE 2
VEHICLE REGISTRATION

Year	Knightdale	Wake County	% Change	North Carolina	% Change
1975	3,779	213,284		3,451,985	
1980		254,752	19.4	4,465,225	29.3
1985	5,993	298,089	17.0	5,457,386	22.2
1990		380,310	27.6	5,651,726	3.6
1993		419,890	10.4*	5,970,288	5.6*

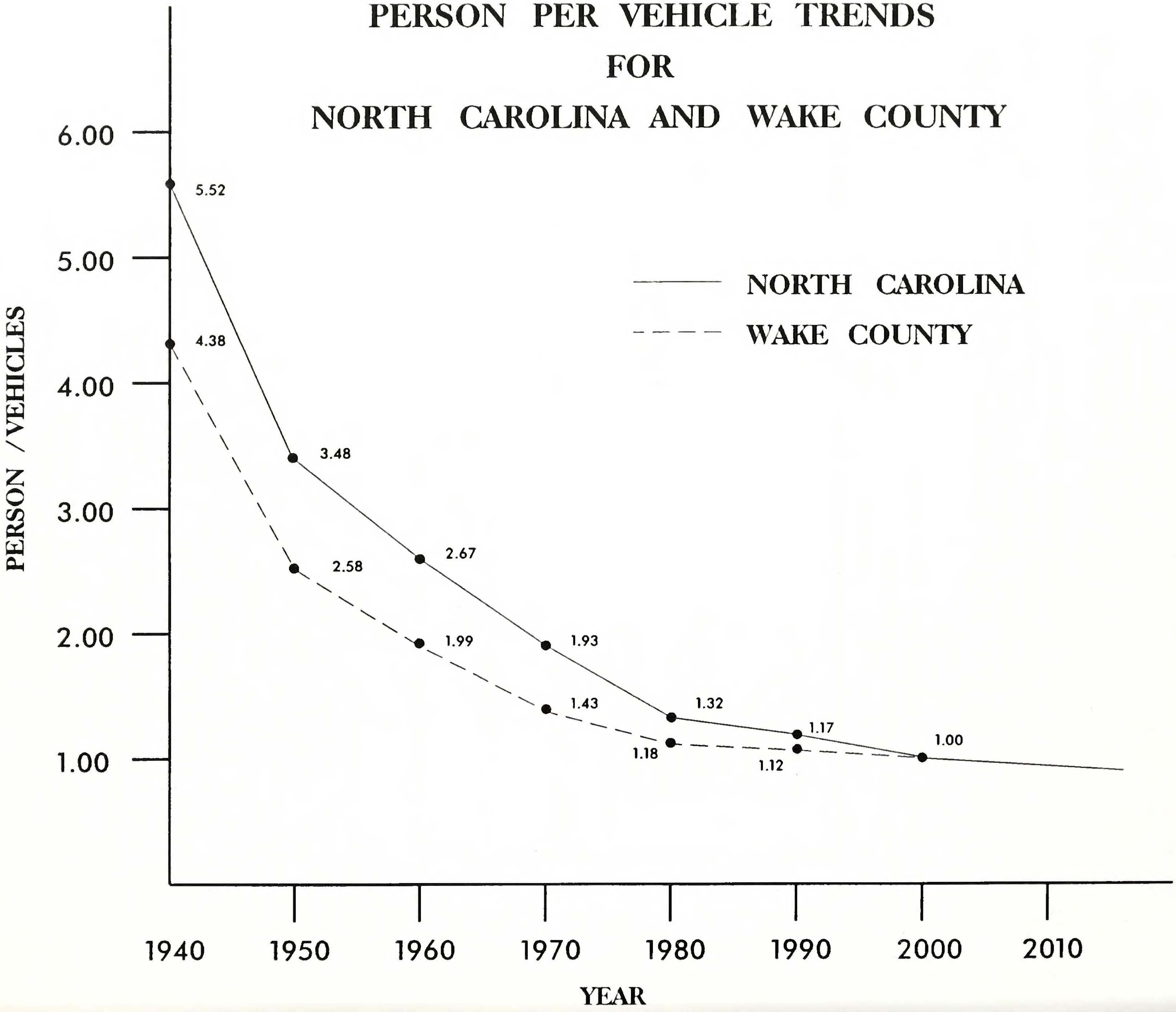
* over a 3 year period

Source: N.C. Division of Motor Vehicles
% Change = ([F/P] - 1.0) x 100.0

Economy and Employment

The economic stability of a given area is an important factor to consider when estimating future travel demands. An area with a good economic base and job market will attract businesses and people which leads to increased development and economic growth.

FIGURE 3



PERSON PER VEHICLE TRENDS
FOR
NORTH CAROLINA AND WAKE COUNTY

Predicting decisions such as new industrial plant locations far in advance of their occurrence can be rather difficult. Therefore, long range projections of population and employment growth are somewhat "iffy." For this reason, variances in predicted versus actual growth should be taken into account during future periodic updates of this study.

According to the Wake county employment figure in Table 3, trade and services are the major employers in the County. In the fourth quarter of 1990, 61,153 people were employed by wholesale and retail traders and 60,877 people were employed by services. In the same year, manufacturers employed nearly 29,000 people compared to 14,589 for construction and 16,456 for finance, insurance and real estate. The figures also show that the total average employment in Wake County has increased steadily from 178,668 people in 1983 to 251,753 people in 1990. Considering these past trends and the area's evident economic stability, it would be logical to expect continued increased employment in Wake County.

TABLE 3
WAKE COUNTY EMPLOYMENT

	1990	1986	1983
Total Average Employ.	251,753	205,062	178,668
Industry Employment			
Manufacturing	28,717	25,874	25,531
Services	60,877	41,250	33,883
Construction	14,589	17,043	15,328
Transportation	16,589	11,532	10,237
Trade	61,153	50,566	41,565
Finance	16,456	13,239	10,779
Mining	332	279	206
Agriculture	1,975	1,317	889

Source: Employment Security Commission

("Transportation" includes transportation, commerce and public utilities; "Finance" includes finance, insurance and real estate; "Agriculture" includes agriculture, forestry and fishing)

Major industries in the Knightdale area are Square D Company and Transmission Networks International, both of which are machinery and parts manufacturers. Other employment in the area is limited to sales and business services.

The Knightdale area has much undeveloped land suitable for both industrial and residential development. The Knightdale area's employment and economy are expected to grow with the development of these areas.

Land Use

The generation of traffic on any street is closely related to the manner in which the land surrounding that street is used. Different types of land uses generate varying volumes of traffic. The spatial distribution of these different types of land uses is the main determinate of when, where, and why traffic congestion occurs. By designating land uses into different types one can determine the spatial distribution of existing land uses which helps predict future land uses and resulting travel patterns.

Land uses can be grouped into the following four types: industrial, commercial, residential, and public and/or recreational. Industrial land use is all land devoted to manufacturing, storage, warehousing, and transportation of products. Commercial land use is all land devoted to retail trade including consumer and business services and offices. Residential land use is all land devoted to the housing of people with the exception of hotels and motels. Public and/or recreational land use is all land devoted to social, religious, educational, cultural and political activities.

The predominant form of land use in the Knightdale planning area is presently residential development. Major concentrations can be found throughout the study area, such as Planters Walk east of Hodge Road, the "Town center", and Sandy Trail off Mailman Road. Future proposed residential development is expected to occur in the area west of Town between US 64 and the Norfolk and Southern Railroad, and to the north of US 64. The Knightdale Land Use Design Plan is shown in Figure 4.

Commercial land use is mainly concentrated along US 64 and along First Avenue in the center of Town. The largest commercial development is Knightdale Crossings Shopping Center located at the corner of Smithfield Road and US 64. Other commercial uses can be found near the intersection of Hodge Road and Old Faison Road, small neighborhood commercial facilities near residential communities should also be encouraged as the area grows.

The major industry in the Knightdale planning area is the Square D Company located on US 64 between Old Knight Road and Marks Creek Road. Other industries in the area are Transmission Networks International located on Forest Drive and the Knightdale Tractor and Equipment Company located on Bethlehem Road. Future industrial sites are located west of the Town and south of US 64. This area provides good access to both US 64 and the Norfolk and Southern Railroad. Other proposed sites for industrial development could be in the area north of US 64 east of Hodge Road.

Significant public and recreational land uses include the Knightdale Town Hall and Park located on Main Street, the Knightdale Elementary School, the Lockhart Elementary School, and the cemetery located at the corner of Pine Street and First

Avenue. Other public and recreational land uses include the Knightdale Baptist Church located on Third Avenue. Future development of public land uses are hard to predict, but consideration should be given to the construction of small local neighborhood parks due to the expected increase in residential development.

KNIGHTDALE LAND USE DESIGN PLAN

(COURTESY OF KNIGHTDALE
PLANNING DEPARTMENT)

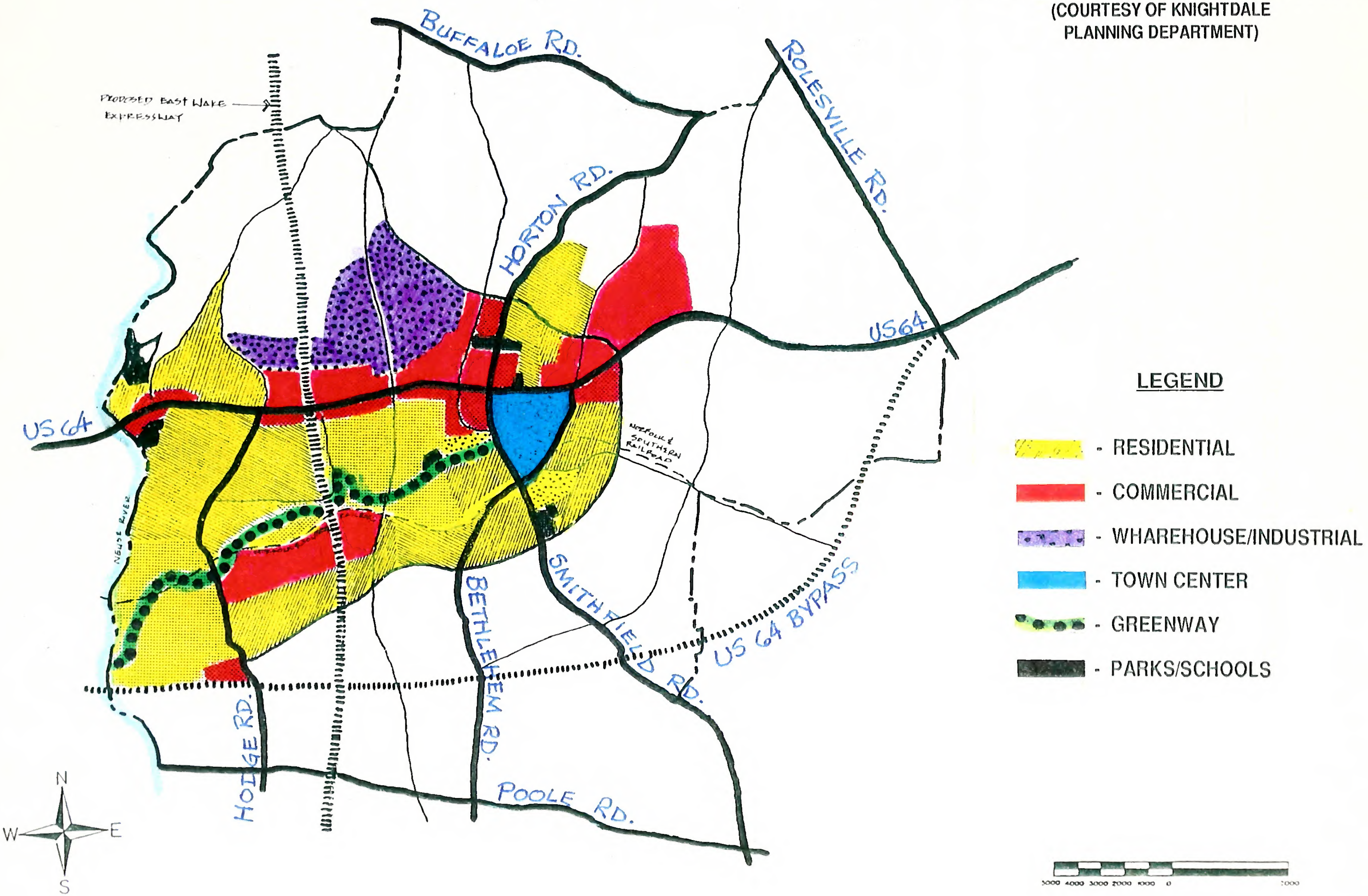


FIGURE 4

IV ANALYSIS OF THE EXISTING SYSTEM

General

This chapter discusses travel deficiencies and the concept of "roadway capacity." Travel deficiencies may be localized and the result of substandard highway design, inadequate pavement width, or intersection controls. Alternately, the underlying problem may be caused by a system deficiency such as a need for a bypass, loop facility, construction of missing links, or additional radials.

Existing Travel Patterns

An indication of the adequacy of the existing street system is a comparison of traffic volumes versus the ability of the streets to move traffic. In an urban area, a street's ability to move traffic is generally controlled by the spacing of major intersections, access control, width of pavement, and the traffic control devices (such as signals) utilized.

Capacity is the maximum number of vehicles which has a "reasonable expectation" of passing over a given section of a roadway, during a given time period under prevailing roadway and traffic conditions. The relationship of traffic volumes to the capacity of the roadway will determine the **level of service (LOS)**. Six levels of service identify the range of possible conditions. Figure 5 shows the levels of congestion associated with the various levels of service. Table 4 gives a brief description of each LOS in accordance with the 1985 Highway Capacity Manual.

The recommended improvements and overall design of the Thoroughfare Plan were based on achieving a minimum of LOS D on existing facilities, and LOS C on new facilities. LOS D is considered the **"practical capacity"** of a facility, or that at which the public begins to express dissatisfaction.

An analysis of the base year street system was made to determine the location, nature, and extent of existing or future deficiencies in traffic-carrying capability. Any given roadway's ability to move traffic is a function of a number of considerations, including 1) pavement width; 2) number of travel lanes; 3) turning lanes, if any; 4) level of access control; 5) spacing of cross street intersections; 6) traffic volumes on cross streets; 7) number, type, and operational characteristics of traffic control devices; 8) horizontal and vertical alignment; 9) posted and operating speeds; and 10) percentage of heavy vehicles.

TABLE 4
LEVEL OF SERVICE

LOS A - describes primarily free flow conditions. The motorist experiences a high level of physical and psychological comfort. The effects of minor incidents or breakdowns are easily absorbed. On an urban arterial, LOS A corresponds to a average travel speed of 25 to 35 mph.

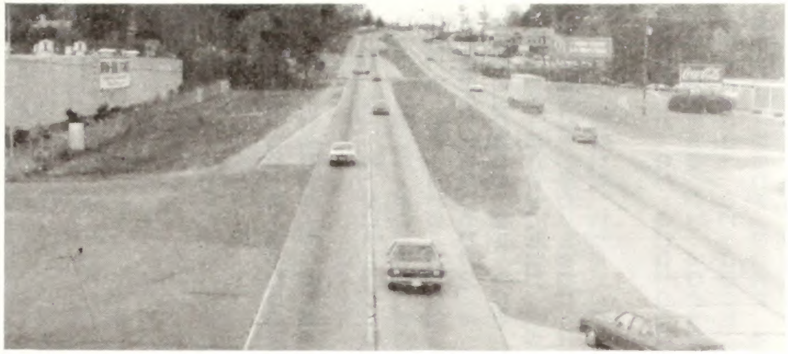
LOS B - also represents reasonably free flow conditions. The ability to maneuver within the traffic stream is only slightly restricted.

LOS C - provides for stable operations, but flows approach the range in which small increases will cause substantial deterioration is service. Freedom to maneuver is noticeably restricted. Minor incidents may still be absorbed, but the local decline in service will be great. Queues may be expected to form behind any significant blockage.

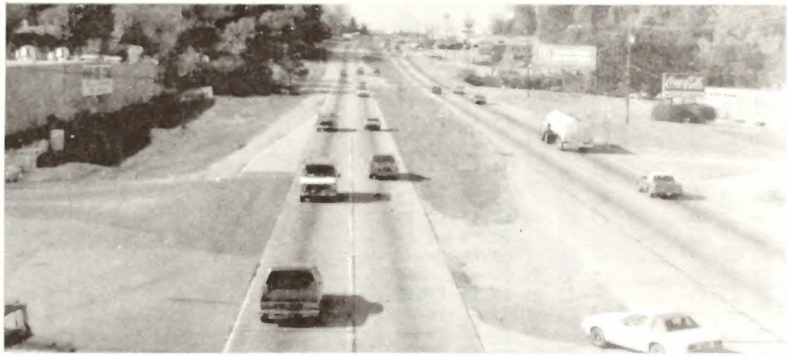
LOS D - borders on unstable flow. Small increases in flow can cause substantial deterioration in service. Freedom to maneuver is severely limited, and the driver experiences drastically reduced comfort levels. Minor incidents can be expected to create substantial queuing. On an urban arterial, LOS D corresponds to an average travel speed of 9 to 17 mph.

LOS E - The boundary between LOS D and LOS E describes operation at **capacity**. Operations at this level are extremely unstable, because there are virtually no usable gaps in the traffic stream. Any disruption to the traffic stream, such as a vehicle entering from a ramp, or changing lanes, requires the following vehicles to give way to admit the vehicle. This condition establishes a disruption wave which propagates through the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate any disruption. Any incident can be expected to produce a serious breakdown with extensive queuing.

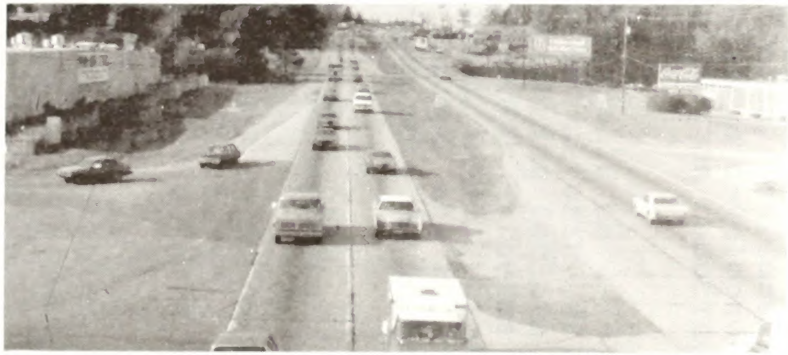
LOS F - describes forced or breakdown flow. Such conditions generally exist within queues forming behind breakdown points.



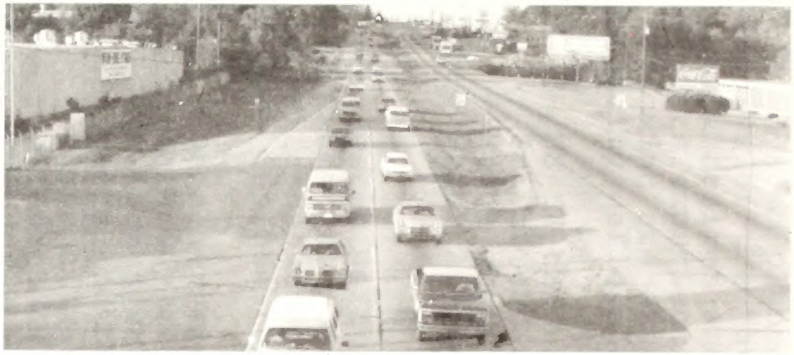
LEVEL OF SERVICE - A



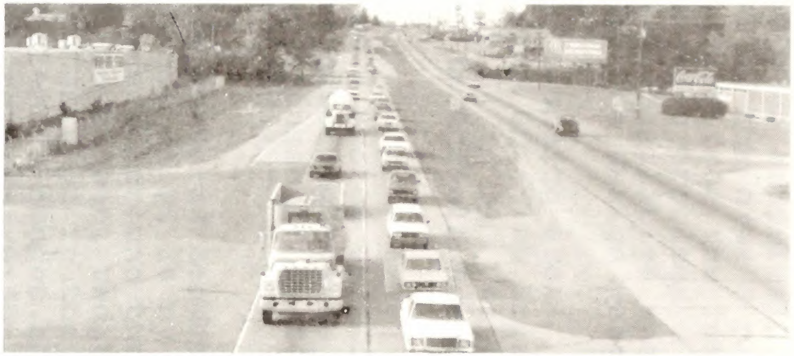
LEVEL OF SERVICE - B



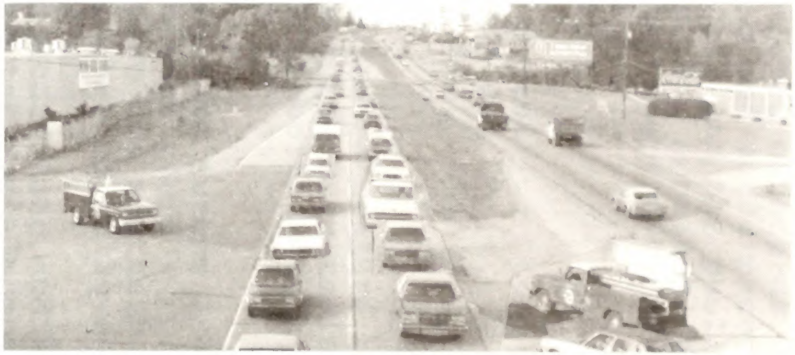
LEVEL OF SERVICE - C



LEVEL OF SERVICE - D



LEVEL OF SERVICE - E



LEVEL OF SERVICE - F

LEVELS OF SERVICE

System planners rely on empirically developed standards, studies of the "nature" of the area's existing and anticipated travel desires and feedback from the local staff and the public on streets experiencing traffic problems. Using this approach, the following are examples of facilities which are expected to have capacity deficiencies by the design year:

- US 64 through the planning area;
- Smithfield Road from US 64 to Broadway Street;
- Hodge road from US 64 to Old Faison Road; and
- First Avenue from Smithfield Road to US 64.

System Deficiencies - System deficiencies are a measure of the extent to which the existing system lacks continuous radials, loops, cross-towns, and bypasses. System deficiencies in the system include:

- an alternate US 64 Route is needed to relieve future capacity deficiencies on US 64 by the design year;
- a loop system is needed around the eastern and southern parts of the Town to connect radial streets and relieve through traffic congestion in the Town; and
- a thoroughfare system is needed between Hodge Road and the Town of Knightdale to prepare for future land development and traffic in that area.

High Accident Location - Traffic accident records are of assistance in defining problem areas and often pinpoint a deficiency such as poor design, inadequate signing, ineffective parking, or poor sight distance. Accident patterns developed from analysis of accident data can lead to remedial action reducing the number of accidents.

Both the severity and number of accidents should be considered when investigating accident data. The severity of every accident is measured with a series of weighting factors developed by the Division of Highways of the NCDOT. In terms of these factors, a fatal or incapacitating accident is 47.7 times more severe than one involving only property damage, and an accident resulting in minor injury is 11.8 times more severe than one with only property damage.

Table 5 shows locations with five or more accidents in Knightdale between 6/92 and 6/94.

TABLE 5
ACCIDENT SUMMARY 6/92-6/94

LOCATION	TOTAL	SEVERITY
1. US 64 and Smithfield Road	32	12.29
2. US 64 and McKnight Drive	19	9.57
3. US 64 and First Avenue (south of 64)	17	10.58
4. US 64 and Old Knight Road (n. of 64)	12	11.56
5. First Ave and Smithfield Road	6	4.02
6. US 64 and Linwood	5	4.62
7. US 64 and Maplewood	5	1.00
8. US 64 and Parkside Commons	5	1.00

The "Total" column indicates the total number of accidents reported within two hundred (200) feet of the intersection during the indicated time period. The severity listed is the average accident severity for that location.

Traffic Forecasts

The Knightdale Thoroughfare Plan report uses traffic projections for the year 2010 which were derived using trend line analysis coupled with information concerning current and future land uses. Future updates to the plan are anticipated to use a computer model of the Triangle Region, which will include Knightdale.

Air Quality

Knightdale is located within Wake County, which is classified as moderate carbon monoxide non-attainment and maintenance for ozone. As Knightdale lies outside any computer modeled area, projects must be examined on a case by case basis as a part of the environmental document process. Additionally, as Knightdale is part of the Metropolitan Planning Organization MPO), Knightdale projects in the State Transportation Improvement Program will be included as needed in air quality analysis. This analysis is performed by NCDOT Statewide Planning for consideration by the MPO in making the air quality conformity finding.

V RECOMMENDATIONS

General

This chapter presents an analysis of the ability of the existing street system to serve the area's travel desires as the area continues to grow, as well as specific elements of the Thoroughfare Plan.

Special Corridors

The Twin-Trailer Routes as designated by FHWA June 5, 1984 and National Truck Network routes as designated by the U.S. Secretary of Transportation for STAA vehicles dated September 1989, include US 64 through Knightdale. The North Carolina Intrastate System also includes US 64.

Alternative Plans

The process of developing, testing and evaluating alternate plans involve a number of considerations. These include identified deficiencies, environmental impacts, existing and anticipated land development, and travel service. Aerial photography, topographic mapping, field reconnaissance and discussion with town staff, officials and interested local citizens provided additional basis for identifying and evaluating the alternative alignments.

Do Nothing Alternative

A "do nothing" alternative was considered in weighing the desirability of developing a thoroughfare plan. This plan is essentially as the name implies, there are no major construction improvements to the system. Regular maintenance would still be performed. Some of the major advantages of the "do nothing" alternative are:

(1) No capital investment.
(2) No removal of landscaping.
(3) No additional land acquisition.
(4) No displacement of people or business as a result of construction.

However, there are a number of disadvantages to a "do nothing" policy which would have significant adverse effects on the urban environment. These include:

(1) Increased traffic congestion on major streets will cause traffic to divert to residential streets.
(2) Existing problem and "bottleneck" situations would worsen.
(3) Increased driving time and road user costs.

(4) Increased air pollution induced by traffic congestion.
(5) Reduced mobility for emergency vehicles.

In addition to the do nothing plan, it is desirable to take a more in depth look at the existing street system to determine if **non-construction** projects can enable the existing system to serve future travel. The applicability of non-construction projects to the Planning Area is as follows:

- **Control of access** increases capacity where highway capacity is reduced by large volumes of turning traffic at many closely spaced locations, such as at a strip commercial zone. Some portions of US 64 are an example of such strip development. As new development occurs, it would be beneficial to attempt to reduce or limit the number of curb cuts. As the remainder of US 64 (and to a lesser extent all major thoroughfares) develops, the transportation network would benefit from the restriction of future and existing access points.

- The implementation of **one-way streets** would increase the capacity of the facilities by up to 50 percent. However, the street system of Knightdale does not lend itself to this type of system, and it is therefore not proposed.

- Prior to a traffic signal being installed on a facility, the through movement is permitted continuously. Upon signal installation, the time permitted for the through movement is significantly reduced to allow for conflicting movements, possibly by as much as fifty percent. This results in a reduced capacity for the facility. It is therefore important that signals only be installed when needed, and with consideration to the overall impact on the facility. Signal locations on US 64 should be coordinated to provide for progression. Improving the progression of the traffic by updating and improving the traffic signal phasing and coordination provides a capacity increase.

- An aggressive **carpool**, **vanpool**, or **public transit** program would process the same number of person-trips while decreasing the number of vehicle-trips and thus decrease congestion. Currently Knightdale does not have an historical pool of vehicle occupancy data to analyze for evaluation of the possible benefits of such a program. Further study of mass transit options will be undertaken as part of the Triangle Regional Model study which includes the Capital Area Metropolitan Planning Organization (CAMPO) of which Knightdale is a part.

- **Altering work hours** such that the beginning and ending times are staggered, can reduce travel in the peak hour. The resulting peak period would be less congested, but last longer. Therefore, the total traffic carrying ability of an existing street can be increased.

- **Restrictions on growth** would also slow traffic growth, and delay the need for street improvements. This approach could adversely affect the economy of the Planning Area. Any approach of this nature would have to be a local decision.

The "do nothing" concept, while an alternative, is not a viable alternative in transportation planning for the planning area.

Adoption of the Plan

The 1987 Proposed Thoroughfare Plan, as shown in Figure 6, was never mutually adopted by the State and the Town of Knightdale. In 1987 the Statewide Planning Branch of NCDOT and the Town of Knightdale mutually agreed to suspend discussions on adopting the Thoroughfare Plan until the Environmental Impact Statement was completed on the portion of the Outer Loop proposed through the area. The uncertainty of whether the Loop should go east or west of Town created a problem locating other thoroughfares that would achieve a logical and efficient street system for the entire planning area.

When the Thoroughfare Plan Study was revived in 1991, Town and NCDOT staff worked cooperatively to provide the Thoroughfare Committee appointed by the Town of Knightdale with meaningful input. A series of public meetings and hearings were held on the Thoroughfare Plan. Throughout the study process, the local and NCDOT staff worked together.

The Knightdale appointed Thoroughfare Committee held meetings in October 1992, January, February and March of 1993. On March 16, 1993 the proposed Thoroughfare Plan was submitted to the Knightdale Planning Board.

April 5, 1993 - the Knightdale Planning Department sponsored an open house for public input on the Thoroughfare Plan. The open house was from 4:30 pm to 6:30 pm, and eight people attended.

April 12, 1993 - A joint public hearing (by the Thoroughfare Committee and the Planning Board) was held on the proposed plan. The Knightdale Planning Board then submitted the plan and recommended the adoption of the Thoroughfare Plan as presented, with the deletion of the McKnight Drive northward extension. It was recommended that the McKnight Drive extension be deleted due to its proximity to an historic site, the Henry H. and Bettie S. Knight Farm.

May 19, 1993 - A Public Hearing was held on the proposed Knightdale Thoroughfare Plan. The Town Council approved the proposed Thoroughfare Plan as submitted (with the McKnight Drive extension).

The Thoroughfare Plan as adopted is shown in Figure 7.

Recommendations

The following sections describe the thoroughfare system in detail. A street by street inventory which includes existing and recommended cross sections, is shown in Appendix B.

Major Thoroughfares - Bypass Facilities

US 64 Bypass - The existing US 64 serves as a primary east-west route for the entire state of North Carolina, as well as the main route for commuters to Raleigh from the east and carries very high peak hour volumes. Present capacity is inadequate for projected volumes and with future commercial development expected long this route, a bypass is recommended.

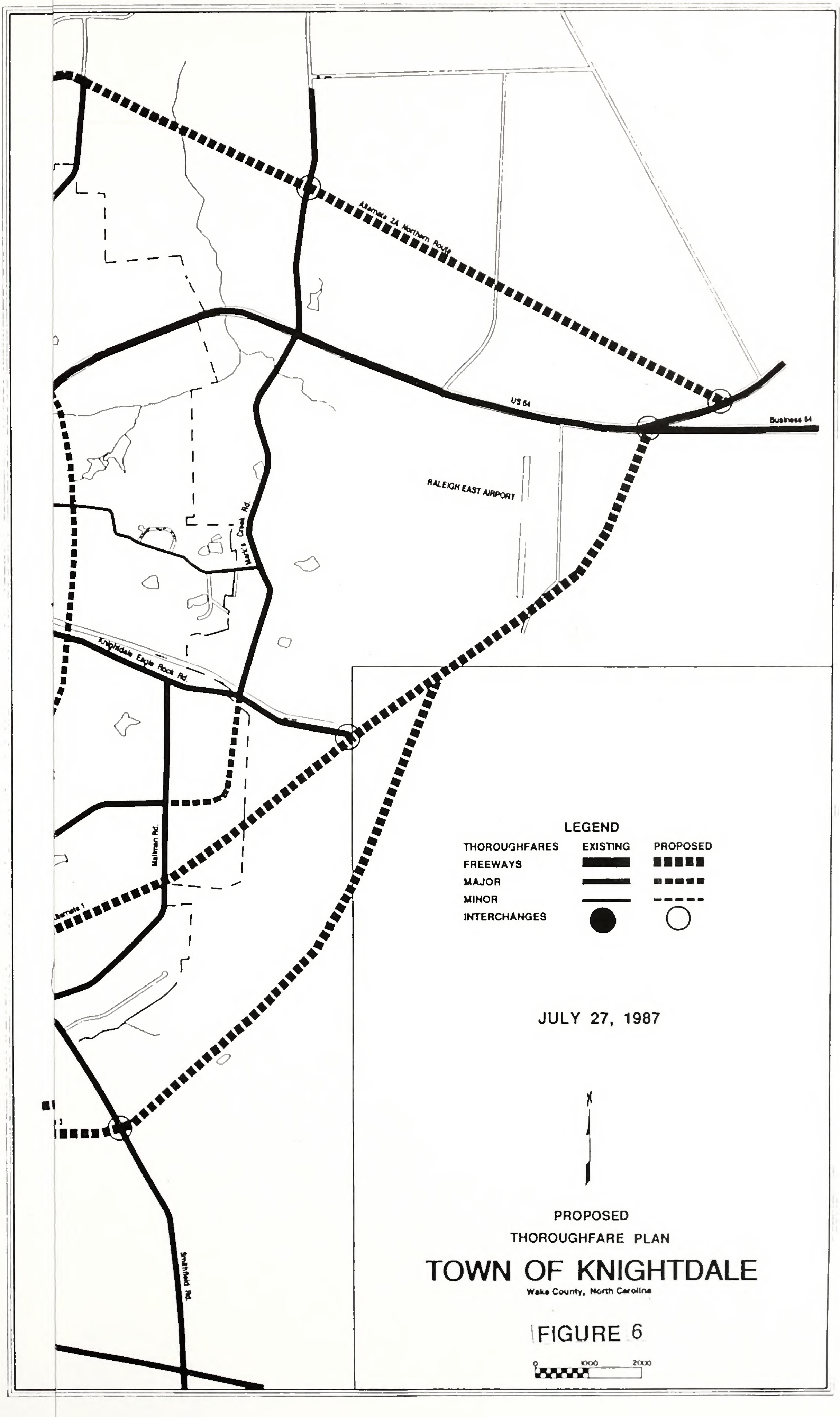
US 64 Bypass is functionally classified as a principal arterial. It is on the National Highway System (NHS) as a Congressional High Priority Corridor. This project is proposed to be a four lane, minimum, freeway with divided median and full control of access. The US 64 Bypass has been scheduled for construction in the NCDOT 1994-2000 TIP as project R-2547. The current schedule calls for construction to begin in 1998. An "Official Map" has been filed by NCDOT for the US 64 Bypass. This instrument is further explained in the next chapter of this report, Implementation.

Eastern Wake Expressway (Outer Loop) - This project is proposed to be a four lane, minimum, freeway with divided median and full control of access. It will run north to south through the planning area approximately east of Hodge Road.

The Eastern Wake Expressway is also scheduled in the NCDOT 1994-2000 TIP. The portion of the facility north of US 64 is scheduled under the Northern Wake Expressway project R-2000. The environmental impact study for R-2000 is complete. The project has been subdivided into smaller sections, with section R-2000 G being the portion between US 64 and Buffalo Road. Construction on this portion of the facility is currently scheduled to begin in late 1999 or early 2000.

The portion of the Eastern Wake Expressway between US 64 and US 64 Bypass is project R-2641. This is identified for right-of-way protection in the NCDOT 1994-2000 TIP. The portion of the Eastern Wake Expressway between US 64 Bypass and I-40 is project R-2829, and is in the TIP as an identified future need.

The location of the Eastern Wake Expressway has been the subject of much debate between the NCDOT and the Town of Knightdale. The Town has indicated that the facility should be placed east of the Town. In adopting the Thoroughfare Plan, it was stated that although the Council did not agree with the location, and may



JULY 27, 1987

PROPOSED
THOROUGHFARE PLAN

TOWN OF KNIGHTDALE

Wake County, North Carolina

FIGURE 6

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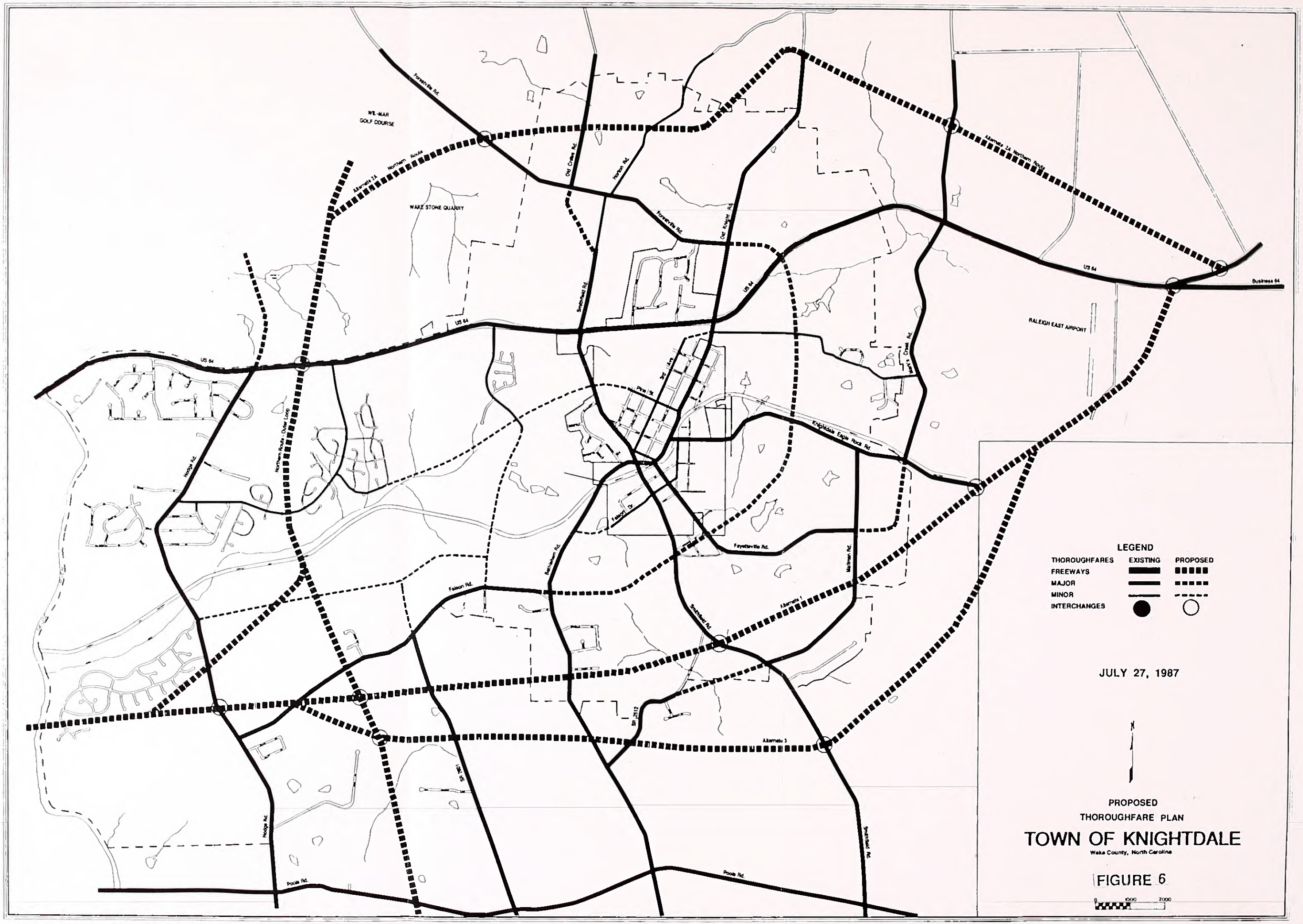


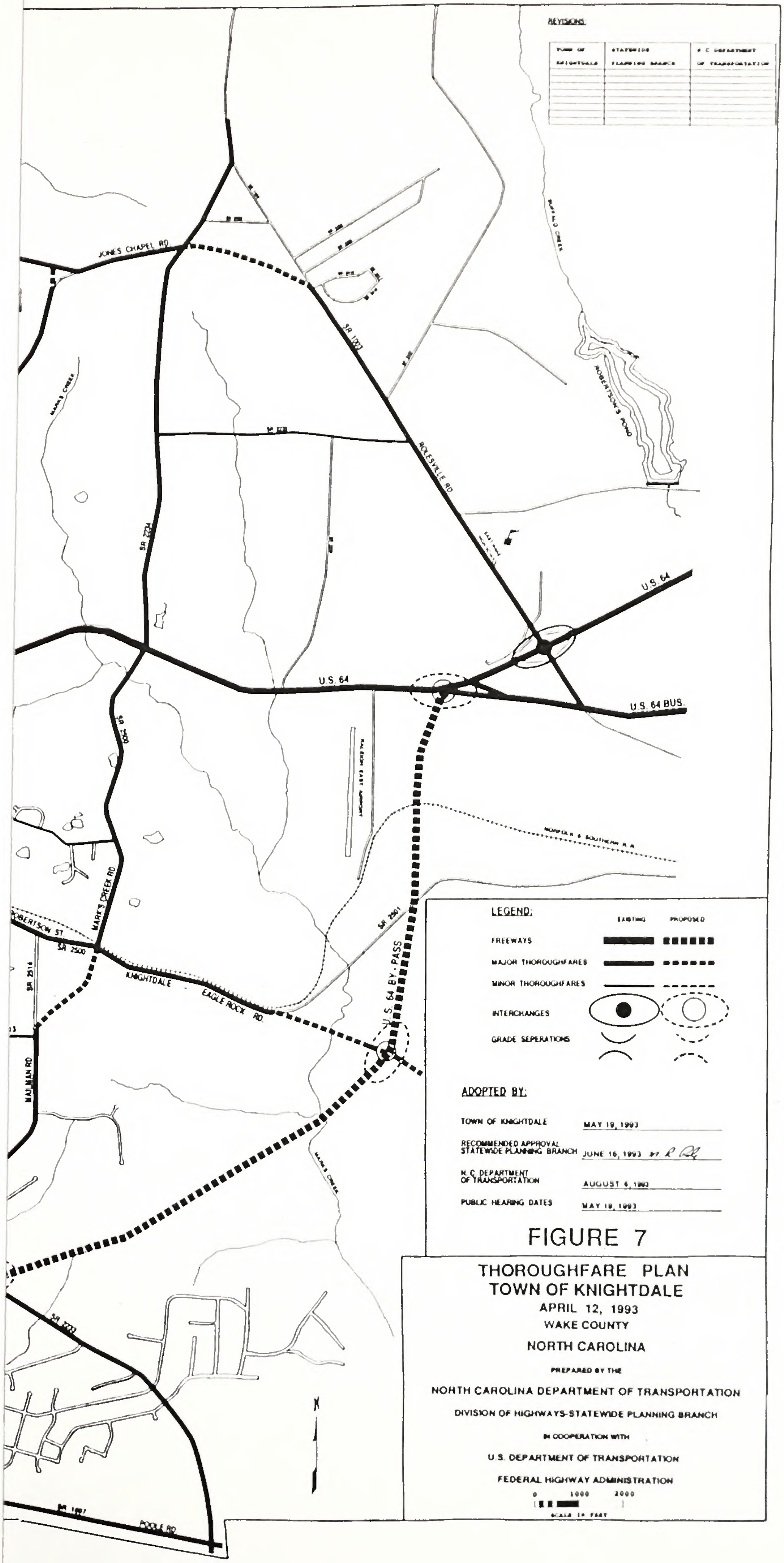
JULY 27, 1987

PROPOSED
THOROUGHFARE PLAN

TOWN OF KNIGHTDALE

Wake County, North Carolina

FIGURE 6



REVISIONS:

TOWN OF KNIGHTDALE	STATEWIDE PLANNING BRANCH	N.C. DEPARTMENT OF TRANSPORTATION

LEGEND:

	EXISTING	PROPOSED
FREEWAYS	▬	■■■■■■
MAJOR THOROUGHFARES	▬	●●●●●●
MINOR THOROUGHFARES	—	- - - - - -
INTERCHANGES	●	○
GRADE SEPERATIONS	⌣ ⌢	⌣ ⌢

ADOPTED BY:

TOWN OF KNIGHTDALE MAY 19, 1993
RECOMMENDED APPROVAL STATEWIDE PLANNING BRANCH JUNE 16, 1993 BY R. [illegible]
N.C. DEPARTMENT OF TRANSPORTATION AUGUST 6, 1993
PUBLIC HEARING DATES MAY 18, 1993

FIGURE 7

THOROUGHFARE PLAN
TOWN OF KNIGHTDALE

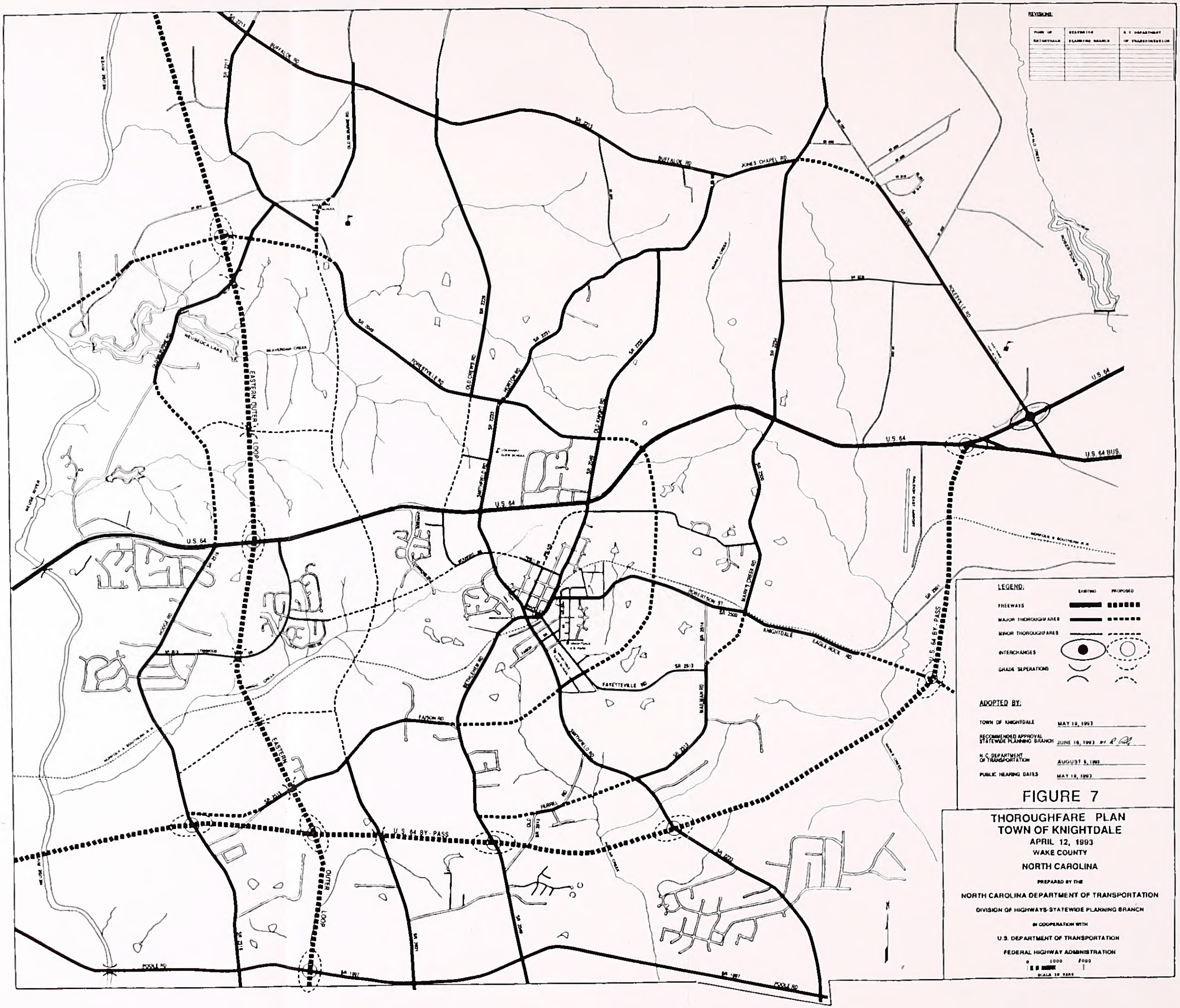
APRIL 12, 1993
WAKE COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS-STATEWIDE PLANNING BRANCH
IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 1000 2000
SCALE IN FEET

REVISIONS:

TOWN OF KNIGHTDALE	STATEWIDE PLANNING BRANCH	U.S. DEPARTMENT OF TRANSPORTATION



ADOPTED BY:

TOWN OF KNIGHTDALE MAY 10, 1993

RECOMMENDED APPROVAL STATEWIDE PLANNING BRANCH JUNE 16, 1993 BY: R. Ol

N.C. DEPARTMENT OF TRANSPORTATION AUGUST 6, 1993

PUBLIC HEARING DATES MAY 10, 1993

FIGURE 7

THOROUGHFARE PLAN
TOWN OF KNIGHTDALE
APRIL 12, 1993
WAKE COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS-STATEWIDE PLANNING BRANCH
IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

continue to oppose it, the likelihood of the facility being built (based upon the EIS, and in part upon other NCDOT studies and a limited Origin-Destination study on US 64 by NCDOT staff) made it such that it should be planned for. The Town does agree with the concept of an Outer Loop, it is merely the location of the facility that is debated.

Major Thoroughfares - Other

US 64 - US 64 is the gateway and most important transportation and commercial corridor in Knightdale. US 64 serves as a primary east-west route for the entire state of North Carolina, as well as the main route for commuters to Raleigh from the east and carries high peak hour volumes. US 64 is functionally classified as a principal arterial. It is on the National Highway System (NHS). Even with the proposed US 64 Bypass in place, US 64 will continue to have high volumes of traffic.

Strip development is becoming problematic between McKnight Drive and Old Knight Road. If the facility is allowed to develop with numerous curb cuts and median breaks, the capacity of the facility will be eroded, and improvements will be needed sooner. It is strongly recommended that curb cuts and median breaks be severely limited. The Town of Knightdale is implementing a marginal access street parallel to US 64 which must be separated from US 64 by at least one lot. This will preserve the traffic carrying ability of US 64 while providing access for development. The Town is to be commended for this local transportation element. The 1991 traffic volume of 31,900 is at the practical capacity of the existing four lane, median section of US 64.

Bethlehem Rd (SR 2049) / First Ave / Old Knight Rd (SR 2232) -This corridor runs the length of the planning area south to north. From Poole Road to the railroad tracks beyond Faison Road, there is sparse residential development. The Thoroughfare Plan calls for an interchange with the proposed US 64 Bypass. Between the railroad tracks and Smithfield Road there is the beginning of commercial development, including the Rescue Squad. Commercial development continues from Smithfield to Robertson Road, and the existing roadway becomes two lanes with parking on both sides. The Knightdale Caboose is located in this area. The ultimate goal is to have a heritage museum in the caboose, surrounded by a small park. From Robertson Street north, the development is again residential, excepting commercial development at US 64. North of US 64 (Old Knight Road) the land use is sparse residential and agricultural.

It is recommended that this corridor ultimately be widened from 2 lanes to 3 lanes from Poole Rd. to US 64.

Buffaloe Road (SR 2215) / Jones Chapel Rd. - The Buffaloe / Rolesville Road corridor was identified by the Knightdale Thoroughfare Committee as being a desirable northern bypass for the Knightdale Area.

Currently Buffaloe Road is two lanes, with spotty residential development. The Horton Road intersection is to be realigned to tee into Buffaloe, which will continue as a through move along Jones Chapel Road. A new connector, making a continuous route, is recommended to Rolesville Road. At this time, there is no development which would negatively affect this new facility.

The 1991 traffic on this route ranged from 1,500 to 3,300 vehicles per day. The Greater Raleigh Urban Area (GRUA) Thoroughfare Plan also includes Buffaloe Road. The GRUA report recommends that Buffaloe Road be 5 lanes on 90' of right-of-way to Forestville Road. To provide for the "northern bypass" concept, a four lane divided cross section is recommended for the ultimate development. Future development should provide for the needed right-of-way, and property access should be by use of an internal street system to make this a viable "northern bypass" for Knightdale to the Outer Loop.

Clifton Road (SR 2601) - This two lane facility is residential with mostly small homes or mobile homes. The US 64 Bypass will be grade separated with no access to this route. It is recommended that this road remain a two lane facility.

Faison Road (SR 2515) - The role that Faison Road plays in the transportation process will significantly change over the next twenty years. Currently Faison Road is a two lane facility with some residential development. In 1991 the traffic ranged from 1,800 to 2,200 vehicles per day.

The importance of Faison Road will change with the construction of the US 64 Bypass. This area is slated by the Town of Knightdale to become commercial / industrial in nature, and with access to US 64 Bypass, access to the entire area becomes greatly improved. The optimum recommendation for this facility would be a four lane, median section. Three lanes would promote strip development. The roadway can be built in staged construction of 2 lanes per phase.

Proposed Faison Road (SR 2515) / Forestville Road (SR 2049) Loop - The recommendation for this facility is a four lane, median cross-section. This proposed road will allow circumferential travel movements in eastern Knightdale as well as providing access for future development in the area. It will connect radial streets outside of the Town allowing movement from one radial street to another without having to go through the downtown area, thus providing relief to the town street system by removing from it traffic which has no desire to be there.

This road should be built by developers as the area develops. Town and/or State projects may eventually be used to supply the missing links. This would be similar to the construction of Cary Parkway in the Town of Cary. Care should be taken by local staff to assure that development patterns in the area provide for the facility as a continuous roadway. It is recommended that the Town acquire a functional design for the centerline of the road. It would be possible to phase the construction of this facility with only two travel lanes being initially constructed on the right of way for a four lane facility.

Old Ferrel Road (SR 2512) / Mailman Road (SR 2513) - Old Ferrel Road is a two lane facility with residential development, and also serves the Akland Orchard near Bethlehem Road. There is a power substation on the south side of Old Ferrel Road near its intersection with Smithfield Road. However, only the center portion of Old Ferrel Road is to be used as a part of the corridor which connects with Mailman Road. Mailman Road is a two lane roadway with residential development, and additionally serves the Sandy Trail residential community. North of Fayetteville Road a new alignment is recommended to provide a continuous route with Marks Creek Road.

The missing links of this road should be mainly built by developers as property develops or as Town projects. Care should be taken by local staff to assure that development patterns in the area provide for the facility as a continuous roadway. Only two travel lanes are needed, however, an additional middle turn lane would be beneficial to remove turning traffic from the travel lanes. Private curb cuts along this thoroughfare should be discouraged, instead promoting the use of a development's internal street network for access.

Forestville Road (SR 2049) - Forestville Road ties to the proposed Faison/Forestville Loop, and travels north-west to the Eastern Wake Expressway, where it will have an interchange. From this point, the facility continues toward Raleigh and becomes Skycrest Drive. Currently Forestville Road is a two lane roadway with sparse residential and agricultural development. In 1991 the traffic ranged from 1,100 to 1,900 vpd. The importance of Forestville Road will grow when it is extended to the Eastern Wake Expressway. The facility is expected to carry up to 12,600 vpd in the design year. This facility should be three lanes on 90' right-of-way to allow for future widening beyond the design period, if needed. This roadway provides for suburb to suburb travel within the Town of Knightdale, and carry traffic to the Eastern Wake Expressway for travel to north Raleigh and the Research Triangle Park.

Hodge Road (SR 2516) - This road runs south from US 64 approximately three miles to Poole Rd. It provides access to residential subdivisions as well as a few businesses. Expectations are for the area between Hodge Road and Knightdale to grow rapidly in the near future. A school has just been proposed for the area. The recommendation for this facility is for four lanes on 70' of right-of-way. Care should be taken in the Mingo Creek area to avoid wetlands as much as possible. It will be necessary to plan for a fifth (turn) lane at both the intersection with US 64 and the interchange with US 64 Bypass. Other locations with high volumes of turning traffic should also be considered for the addition of a turn lane.

The Greater Raleigh Urban Area (GRUA) Thoroughfare Plan also includes Hodge Road. Preliminary design for the interchange calls for it to be a half-clover on the west side of Hodge Road. Additionally, both the Knightdale and GRUA Thoroughfare Plans show a future extension of Hodge Road north of US 64, tying to Old Milburnie Road. This facility will provide land access while the adjacent Eastern Wake Expressway will provide for travel.

Horton Road (SR 2231) - Horton Road is essentially the continuation of Smithfield Road. These two streets will form one continuous route which will provide for north-south travel between Poole and Buffaloe Roads. Land use is primarily residential and agricultural, with mobile home developments. Two 12′ lanes are recommended, unless the route continues to provide private property access, then there will be a need for a continuous center turn lane. There is an offset at Forestville Road which will need to be re-aligned. This can be accomplished by slight adjustments of both Horton and Smithfield Roads at the ends.

Marks Creek Road (SR 2500) / SR 2234) - Marks Creek Road is essentially the continuation of Ferrel / Mailman Roads. The projected traffic 4,000 vpd, and three lanes are recommended for the proposed portion to allow for growth beyond the design year. The intersection with US 64 should receive careful study to determine the needed number of turning lanes and appropriate storage lengths.

Old Crews Road (SR 2228) - This facility, with its southern extension (see McKnight Drive Extension North), provides for northward travel from US 64 to Buffaloe Road and beyond to the town of Rolesville. A substation exists in the south west quadrant of the intersection of Old Crews and Buffaloe Roads. While there is only small demand for this facility at the present, once utilities are extended to this area, development will quickly increase travel volumes. For the planning period, two lanes appear adequate, however, for long range planning purposes, three lanes are ultimately recommended.

Poole Road (SR 1007) - This is a two lane facility which currently provides access to scattered residential development. The traffic volume in 1991 for this facility was 4,500 vpd. The Greater Raleigh Urban Area (GRUA) Thoroughfare Plan also includes Poole Road. The GRUA report recommended that Poole Road be 5 lanes on 90′ of right-of-way west of the Eastern Wake Expressway. An interchange with the Eastern Wake Expressway and Poole Road is planned.

Robertson Street (SR 2500) / Knightdale Eagle Rock Road - This route starts at First Street, and continues east across the railroad tracks. Between the railroad tracks and the Knightdale Town limit, there is residential development, and a fire station.

For most of the planning area, this road closely parallels the Norfolk and Southern Railroad, with scattered residential development. Wake County Solid Waste Container Site #10 is along this facility. This route is proposed to be realigned to tie to the US 64 Bypass with an interchange which will increase traffic demand. The Thoroughfare Plan recommendations call for two lanes, with right of way adequate to widen after the US 64 Bypass is in place.

Rolesville Road (SR 1003) - Rolesville Road has an interchange with US 64. The traffic on Rolesville Road in 1991 was 2,100 vpd. Immediately north of the interchange is East Wake High School, tennis courts, stadium, and East Wake School Park. Improving this two lane facility will be difficult due to these public lands. This road will be part of the "northern bypass" of Knightdale, when coupled with Buffaloe Road, and is recommended to be a four lane divided facility. Beyond the school and park, the land is sparsely developed residential and agricultural.

Smithfield Road (SR 2233) - This road serves as a major connector for US 64 and the Knightdale Town center area. Sparse residential development is predominant between Poole Road and Old Ferrel Road. North of Old Ferrel Road there is a residential / commercial mix, with Knightdale Elementary School and a post office just before the railroad tracks. From McKnight Drive to north of US 64, Smithfield Road has a high concentration of commercial development.

Any attempts to widen Smithfield Road north of US 64 will pose unique problems. Immediately west is an old church, while to the east large old trees line the roadway, with a restaurant immediately beyond. The vertical grade crossing US 64 poses sight distance problems. Just further north on Smithfield Road there is a cemetery on the west, and the Lockhart Elementary School on the east.

On Smithfield Road, the 1991 traffic volumes south of US 64 were 7,400 vpd and north, 2,200 vpd. Currently Smithfield Road is two lanes, except the section between McKnight Drive and US 64, which has been widened to three lanes. The McKnight Drive / Old Crews Road connector will provide some much needed relief to Smithfield Road when it is constructed.

Minor Thoroughfares

McKnight Drive Extension North - This road should be extended from US 64 to Forestville Road at its intersection with Old Crews Road. The extension of the facility will affect a home and pond directly at Old Crews Road. This facility will help relieve the traffic burden on Smithfield Road and its intersection with US 64. This facility will serve as a missing link in the system, as well as a route for commercial traffic. The area in the north of US 64 and between this extension and Smithfield Road is commercial/industrial, and will continue to develop in this manner.

This road should be built by developers as property develops. Care should be taken by local staff to assure that development patterns in the area provide for the facility as a continuous roadway. A three lane facility on 60' right-of-way should be planned for this link. The alignment will have to veer slightly to the east at US 64 to avoid the historic Henry H. and Bettie S. Knight Farm, which has great importance for the Knightdale area. It is likely that the existing brick, non-historic, home would have to be taken, although it may be possible to avoid it, should the developer desire.

Extension from SR 2601 to Old Milburnie Road - This minor thoroughfare provides for north-south movements through the western side of Knightdale. It will provide good industrial and commercial access from the land area proposed by the Town to be developed as such. The north end of the facility should line up with the realigned portion of Old Milburnie road near East Wake Middle School.

This road is a local responsibility, and should be mainly built by developers as property develops. Care should be taken by local staff to assure that development patterns in the area provide for the facility as a continuous roadway.

Pine Street - This two lane residential street currently connects Fourth Avenue to First Street. It is to be extended to the west to Smithfield Road at McKnight Drive, then on to Laurens Way in Planters Walk subdivision. Functionally, Pine Street and its extension collects traffic from nearby residential property, as well as provides access for several business concerns, such as the Wall Mart Shopping Center. Two lanes is recommended.

3rd Avenue - This two lane residential road is starts on Main Street directly across from the entrance to the current Town Hall. It is to be extended from Pine Street north and then east to First Avenue. This will create another route parallel to First Avenue which should help relieve some of the congestion on First Avenue by permitting local destined traffic to use the smaller route. It is recommended that the existing Third Avenue remain a two lane section. The new section from Pine Street to First Avenue is also proposed to be a two lane section.

Lynnwood Drive (SR 2619) - This is the spine road through Planters Walk Subdivision. It is a two lane facility with adequate room for turning bays where needed; no improvements are recommended for this facility within the subdivision. Through Lynnwood Estates subdivision, the street should be upgraded to two 12' lanes, with a turning bay at Hodge Road. The through movement should be changed to go from Planters Wake to Lynnwood Estates to Hodge Road.

Maple Street - This is a two lane, residential facility which connects Smithfield Road and First Street. No improvements are recommended for this facility.

Fayetteville Road (SR 2513) - Fayetteville Road is a minor thoroughfare which ties First Street to Mailman Road. It is a two lane facility, which is mainly residential and agricultural. It runs behind the Knightdale Elementary School and soccer fields. This road is recommended to remain a two lane facility.

Faison Drive / Hester Street - These residential streets should be widened to 24 feet to safely accommodate future traffic.

Massey Farm Road / Marshall Drive - This is an eastward continuation of the Third Avenue Extension. It provides access to residential communities, as well as distributes traffic between First Avenue and Marks Creek Road. Currently this is more a dirt path than a roadway. It is proposed that this road will allow east-west travel movements in eastern Knightdale as well as providing access for future development in that area. The recommended cross-section is two lanes.

Outer Loop crossovers - The exact location of these facilities has yet to be determined. However, as residential development occurs, it is necessary that a corridor either be constructed or reserved to allow for this facility on sixty feet of right-of-way. This is a task on which Knightdale, Raleigh and Wake planners must work in concert in order to achieve. One of the crossovers will be north of US 64, and the other south. These facilities are important to insure that the Eastern Wake Expressway does not become a "wall" to the Town of Knightdale, cutting it off from development and access to the west.

Puryear Road (SR 2235) - This road provides for a connection between Marks Creek Road and Rolesville Road. It is two lanes, dirt road. Paving to two lanes is recommended.

Traffic Operations

Traffic signal progression should be studied and revised as needed. As a part of this study, locations for future signals should be considered to provide for future progression patterns. It should be stressed that contrary to popular belief, traffic signals are not always the solution to traffic problems, and in fact, typically worsen the problem if utilized incorrectly.

Facilities should be designed such that the integrity of the road is not compromised with excessive curb cuts.

There are two-lane roads in the Knightdale area which have paved widths less than 22′, which is the **minimum desirable cross-section.** The desirable lane width of 12′ yields a 24′ paved roadway. Narrow roadways increase the likelihood of accidents between vehicles traveling in the opposite direction. This becomes more critical as traffic increases to 5,000 or 6,000 vpd, as there is increased incidence of meeting oncoming traffic.

Summary of Recommendations

This report contains numerous recommendations for the Knightdale transportation system. The following is a brief review of these recommendations, with additional notation as to where in the report a more detailed discussion can be found.

Cross-sections - Each facility on the Thoroughfare Plan is discussed in detail earlier in this chapter. A summary of the recommended cross-sections for each facility is in Appendix B. The minimum desirable cross-section is twenty-two feet with paved shoulders or curb and gutter. The desirable lane width is twelve feet.

New Facilities - New facilities are needed throughout the planning area. They provide for continuity of travel, corridor spacing, and/or a more direct travel path. Some of the more important new facilities recommended by the Plan include:

- McKnight Drive extension
- US 64 Bypass
- Eastern Wake Expressway
- Extension from SR 2601 to Old Milburnie Road

Systems Improvements - Often system improvements can provide additional capacity or improved traffic conditions, with a minimum of capital outlay. Recommended system improvements include:

- Consideration of an aggressive carpool/vanpool program and collection of vehicle occupancy count data. The capacity of a facility to carry people can be increased by increasing the occupancy of the existing vehicles.

- Encouragement of local businesses to stagger work hours to decrease traffic volume in the peak travel hours.

- A continuing program to assure proper timing and phasing of all traffic signals. Proper signal progression can have significant positive impact on a corridor, this is especially true for the US 64 corridor.

- Protection of access control is one of the areas where a significant contribution can be made. Specific corridors, such as US 64, and other major thoroughfares, should be protected from unrestricted access.

- A single unprotected left turning car can expend the capacity equivalent of five through vehicles. The cross-section recommendations presume that left turns at key intersections are provided for.

VI IMPLEMENTATION

General

Many considerations go into determining the actual staging of a highway project. Political, social, environmental, and economic considerations all have their influence. The adoption of the Thoroughfare Plan by the Town and State does not include the order of priorities. Priorities are reviewed and set by the towns and county yearly. User benefits, cost, economic development potential, environmental impact, and relationship to the state arterial system provide a basis for rating the relative importance of proposed projects. Table 6 should be used to assist the decision makers - the Knightdale Town Council, Wake County Commissioners, and the North Carolina Board of Transportation.

Construction Priorities

A Thoroughfare Plan study uncovers the need for new facilities, plus identifies existing and future deficiencies in the transportation system. The Thoroughfare Plan is a representation of the existing highway system by functional use (major thoroughfare, minor thoroughfare, or local street) plus any new facilities which are needed. The planning methodology enables identification of deficiencies in the existing system, allowing compilation of a list of needed improvements. The list is divided into four priority groups indicating the degree of importance associated with each proposal from the technical perspective. The new facilities are a vital part of the Plan, in that the General Statutes of North Carolina gives local municipalities the authority to protect proposed corridors.

Table 6 provides an alphabetical listing of priority groupings of the recommended highway projects, and the estimated cost in 1992 dollars of each project. Appendix B contains the Thoroughfare Plan Street Tabulation and recommendations.

Priority Group 1 consists of all projects listed in the 1994-2000 editions of North Carolina's Transportation Improvement Program (TIP). Priority Group 2 improvements are centered around alleviating current traffic deficiencies and strengthening the existing highway system. Priority Group 2 includes widening thoroughfares within the Knightdale area and construction of new corridors. Strong enforcement of subdivision and zoning ordinances will enhance the implementation of these projects.

Priority Group 3 projects are needed in the future to provide for anticipated growth. As many of these projects will not be implemented in the near future, continued protection of the corridors is critical. Strong enforcement of local ordinances, particularly set-back and right-of-way reservation requirements, will enhance the implementation of these projects, by ensuring there will be a corridor to locate the facility.

The above three Priority Groups represent the "essential" highway needs for the area. Based on past implementation history, it appears unlikely that all of the elements of Priority Group 2 and only a few in Priority Group 3 will be constructed within the Plan's design period. This does not mean that the recommended corridors should not be protected. On the contrary, unless subdivision controls and zoning ordinances are fully utilized, corridors for new facilities will probably not be affordable at any future date. Compromises for various reasons may be required in the implementation of a long range transportation plan, but care should be exercised not to jeopardize major elements or the intent of the Plan.

Physical, Environmental Factors

Air quality studies have reported that the internal combustion engine used in motor vehicles causes about three-fourths of the carbon monoxide, half the hydrocarbons, and nearly half the nitrogen oxides in the atmosphere. The design of the thoroughfare system can have a crucial effect on the amount of pollutants added to the atmosphere. Auto emissions of two major pollutants causing air quality concerns in the United States today, carbon monoxide and hydrocarbons, are reduced wherever traffic is permitted to flow smoothly, and where congestion and "stop and go" driving conditions are reduced. This reduction of pollutants is created by the more efficient burning of fuel under free flow conditions. The layout of the major street system will also have an effect on air quality. A street system that provides easy and direct movement between all sections will reduce travel time and distances, thereby reducing pollutant emissions.

Wake County is designated as a moderate non-attainment area for carbon monoxide and ozone. This designation also pertains to the Knightdale area as it is within Wake County. On a qualitative level, the Thoroughfare Plan contributes to the reduction of emissions as it lessens congestion and provides more direct paths for travel. As projects are selected for implementation, a detailed air-quality analysis must be completed.

Water quality is a prime asset of all cities and every effort should be made during highway construction for the prevention of pollution. Guidelines have been issued outlining procedures for maintaining water quality and the reduction of possible soil erosion that takes place during and following highway construction.

TABLE 6

RECOMMENDED PRIORITY GROUPS

CORRIDOR Section	LENGTH mile (km)	EXISTING X-SECTION	PROPOSED X-SECTION	PROP. ACCESS CONTROL	CONST. COST (X $1,000)	ROW COST (X$1,000)	PROJECT NO.
PRIORITY GROUP 1							
EASTERN WAKE EXPRESSWAY South of Buffalo Road to US 64	5.4 (8.7)	N/A	4 dv	full	26,300	10,000	R-2000 SectionG
EASTERN WAKE EXPRESSWAY US 64 to US 64 Bypass	2.0 (3.2)	N/A	4 dv	full	35,100	-	R-2641
US 64 BYPASS I-440 to US 64 / US 264	10.2 (16.4)	N/A	4 dv	full	54,200	11,000	R-2547

CORRIDOR Section	LENGTH mile (km)	EXISTING X-SECTION	PROPOSED X-SECTION	PROP. ACCESS CONTROL	CONST. COST (X $1,000)	PROBABLE IMPACTS Econ. Develp	Environment +	Environment -
PRIORITY GROUP 2								
Buffaloe Road (SR 2215)								
Old Milburnie Rd-Marks Creek Rd	3.20	18 (2 ln)	G (4 dv)	partial	6,800	.60	.10	.10
Marks Creek Rd. - Rolesville Rd	0.58	N/A	G (4 dv)	partial	11,000	.50	.10	.10
Forestville Road (SR 2049)								
Old Knight Rd - s. Old Milburnie	2.50	19 (2 ln)	I (3 ln)	partial	2,000	.60	.30	.30
Hodge Road (SR 2516)								
US 64 Byp. - US 64	2.14	20 (2 ln)	H (4 ln)	none	2,300	.60	.20	.40
Lynnwood Drive (SR 2619)								
Lynnwood - Hodge Road	0.28	18 (2 ln)	I (3 ln)	none	300	.10	.40	.20
McKnight / Laurens Way Connector	0.93	N/A	I (3 ln)	partial	1,200	.40	.10	.10
Poole Road (SR 1007)								
Hodge Road - Bethlehem Road	1.96	22 (2 ln)	D (5 ln)	none	2,500	.50	.10	.10
Rolesville Road (SR 1003)								
US 64 - Buffaloe Extension	1.85	20 (2 ln)	G (4 dv)	partial	3,900	.40	.20	.40
Smithfield Road (SR 2233)								
Broadway - Bethlehem Road	0.53	18 (2 ln)	D (5 ln)	none	700	.40	.40	.40
Bethlehem Rd. - US 64	0.80	18 (2 ln)	D (5 ln)	none	1,200	.60	.40	.20
US 64 - Forestville Road	0.74	18 (2 ln)	I (3 ln)	none	900	.90	.20	.60

CORRIDOR Section	LENGTH (mile)	EXISTING X-SECTION	PROPOSED X-SECTION	PROP. ACCESS CONTROL	CONST. COST (X $1,000)	PROBABLE IMPACTS Econ. Develp	Environment +	-
PRIORITY GROUP 2								
US 64								
Hodge Road - US 64 Business	5.28	48 (4 dv)	M (6 dv)	partial	8,500	.80	.40	.40
Eastern Wake Expressway crossovers	1.0	N/A	I (3 ln)	partial	1,300	.60	.20	.20
PRIORITY GROUP 3								
Bethlehem Rd (SR 2049)/First Ave								
Poole Rd - Old Faison Road	1.62	18 (2 ln)	I (3 ln)	none	1,300	.10	.10	.10
Old Faison Rd. - Smithfield Rd	0.93	18 (2 ln)	I (3 ln)	none	750	.30	.40	.20
Pine St. - US 64	0.52	24 (2 ln)	I (3 ln)	none	400	.60	.40	.40
Hodge Road (SR 2516)								
Poole Rd. - US 64 Bypass	1.08	20 (2 ln)	H (4 ln)	none	1,300	.60	.20	.40
Mailman Road (SR 2513)								
Fayetteville Rd. - Robertson St	0.44	N/A	I (3 ln)	partial	600	.40	.10	.10
Old Faison Road (SR 2515)								
Hodge Rd. - Bethlehem Road	1.99	20 (2 ln)	G (4 dv-S	partial	2,000*	.60	.20	.20
Old Ferrel Road (SR 2512)								
Bethlehem Rd. - Smithfield Rd	1.06	20 (2 ln)	I (3ln)	none	1,500	.20	.20	.60
Poole Road (SR 1007)								
Bethlehem Rd. - Smithfield Road	2.10	22 (2 ln)	D (5 ln)	none	2,600	.40	.40	.40
Puryear Road (SR 2235)								
Marks Creek Rd. - Rolesville Rd	1.08	20 (2 ln)	L (2 ln)	none	800	.10	.10	.10
Clifton / Old Milburnie Connector	4.10	N/A	G (4 dv-S	partial	4,100*	.60	.40	.60
Faison / Forestville Loop								
Old Faison Rd. - Smithfield Rd.	0.72	N/A	G (4 dv-S	partial	800*	.50	.10	.40
Fayetteville Rd. - Old Knight Road	1.94	N/A	G (4 dv-S	partial	2,000*	.50	.10	.40
McKnight / Old Crews Connector	N/A	N/A	I (3 ln)	partial	1,200	.80	.10	.40

* first phase

Benefits and Construction cost in 1992 dollars.
For complete Thoroughfare Plan Street Tabulation, see Appendix **B**

Definitions

3 ln	Three lane roadway
4 dv	Four lane divided roadway (with median)
2lnp	Two lane roadway plus parking lane
N/A	Not applicable

Explanation of Items in Table 6

Priority Group - There are four Priority Groups, as explained earlier in this chapter. Priority Group 4 includes any remaining improvements listed in the Street Tabulation (Appendix B), and not listed in Table 6. Project types found in this Group include minor widening, and projects which have merit but are not warranted within the planning period.

Length - The length of the project, in miles.

Proposed X-Section - This is a shortened term for "Proposed Cross-Section". For additional information, see Appendix B.

Prop. Access Control - "Proposed Access Control". "Full" denotes access with public streets only, with no private property driveways. "Partial" indicates access at a limited number of points, which can be implemented through local subdivision ordinances by requiring private lots to be served by the development's internal street network. Facilities with partial access control can have a combination of interchanges and at-grade intersections. The notation "none" in the access control column indicates all lesser forms of access control, including no control at all.

Development on major thoroughfares should be strongly encouraged to provide internal street access for all lots. This results in higher capacity for the thoroughfare, and increased safety overall due to fewer turning conflicts. In commercial areas, lack of access control results in undesirable strip development. Not only can this be unsightly, but this type of development restricts the capacity of a facility, and results in numerous traffic signals, congestion and delays.

Const. Cost (X $1,000) - The estimated construction cost, in thousands of dollars, of the project (in 1992 dollars). Note that right-of-way costs are in addition to construction costs, and can be 50% or more of construction costs.

Probable Impacts - Probable impacts include both economic development and environmental impact.

Economic Development - "A project can be successful by stimulating economic development in the immediate area of the project or by increasing the level of service of accessibility to an adjacent area. The probability of a project's success in achieving this objective is affected by the overall potential for economic growth in the urban area. . . . The estimate of probabilities is a subjective evaluation by the analyst based on his knowledge of the proposed project, urban development characteristics, and land development potential."

Table 7 may be used as a guideline for interpreting the "Probable Impact" values in Table 6.

Environmental Impact - "Environmental factors usually considered in highway project evaluation can be separated into three major categories--(1) physical environmental considerations, (2) social and/or cultural environmental considerations, and (3) economic environmental considerations. Factors included in each of these categories are given in Table [8]."

PROBABILITY ESTIMATION GUIDE - TABLE 7	
Subjective Evaluation	Impact Probability
Excellent - very substantial	0.90
Very good - substantial	0.60
Fair - some	0.40
Poor - none	0.10

"It is desirable that the evaluation of environmental impacts be condensed to a single measure or measures easily understood by the decision maker. In the benefits matrix model the approach is to estimate the probability of a positive or negative impact for each of the environmental factors. The summations of both positive and negative probabilities are then measures of the relative environmental impact of a project.

"Information from public involvement and environmental analysis elements of urban transportation studies provide a basis for estimation of probabilities for projects. If no urban transportation studies have been made, it would be necessary to rely on other planning studies and reports, or field surveys."

ENVIRONMENTAL CONSIDERATIONS - TABLE 8		
Physical Environment	Social and/or Cultural Environment	Economic Environment
Air quality	Housing	Business
Water resources	Neighborhoods	Employment
Soils and geology	Noise	Economic Development
Wildlife	Education facilities	Public Utilities
Vegetation	Churches	Transportation costs
	Parks and recreation	Capital costs
	Public health and safety	Operation and maintenance costs
	National defense	
	Aesthetics	

Implementation Scenarios

Spiraling right-of-way cost has greatly reduced the ability of the State to fund highway improvements. Initiative for plan implementation will rest largely with the local policy boards involved in the Plan's development (Knightdale Town Council, and Wake County Commissioners).

The remainder of this report will briefly review the administrative controls and implementation tools available to decision makers, and indicate which of these tools should be considered in implementing the recommended proposals. Prudent use of these tools ensure that the transportation system will achieve a safe, efficient movement of people and goods in a timely and economical manner.

Administrative controls and implementation tools which can aid in the implementation process are generally available to municipalities through Federal and State Legislation. These will be discussed in this chapter. They include: Subdivision Regulations; Zoning Ordinances, Official Maps, Urban Renewal, Capital Improvements Programs and construction. Generally, two issues play a major role in the implementation process -available finances and citizen involvement. Effective use of the tools listed above minimize the effects of limited finances. It is through good planning that maximum use is made of every available dollar and that citizen involvement and approval of the transportation plan is obtained.

State and Municipal Adoption of the Thoroughfare Plan

Chapter 136, Article 3A, Section 136-66.2 of the General Statutes of North Carolina provides that after development of a thoroughfare plan, the plan may be adopted by the governing body of the municipality and the Board of Transportation to serve as the basis for future street and highway improvements. The General Statutes also require that, as part of the plan, the governing body of the municipality and Department of Transportation shall reach agreement on responsibilities for existing and proposed streets and highways included in the plan. Facilities which are designated a State responsibility will be constructed and maintained by the Division of Highways. Facilities which are designated a municipal responsibility will be constructed and maintained by the municipality.

After mutual plan adoption, the Department of Transportation will initiate negotiations leading to determination of which existing and proposed thoroughfares will be a Departmental responsibility and which will be a municipal responsibility. Chapter 136, Article 3A, Section 136-66.1 of the Federal Statutes provides guidance in the delineation of responsibilities This statute stipulates that the Department of Transportation shall be responsible for those facilities which serve volumes of through traffic and traffic from outside the area to major business, industrial, governmental, and institutional destinations located inside the municipality. The municipality is responsible for those facilities which serve primarily internal travel.

Thoroughfare plan adoption enables other planning tools such as the subdivision ordinance, zoning ordinance, official street map, and capital improvement program to be used to assist in plan implementation and thus minimize public cost, environmental cost, and land use disruption.

Subdivision Control

Subdivision regulations are locally adopted laws governing the process of converting land into building sites. A subdivision ordinance requires that subdividers submit to the City Planning Commission a plot of the proposed subdivision. Certain standards must be met by the developer before he can be issued a building permit to construct his development. Through this process, it is possible to reserve or protect the necessary rights-of-way for projected streets which are a part of the thoroughfare plan and to require street construction in accordance with the plan.

Subdivision regulations may provide such benefits as requiring portions of major streets to be constructed in accordance with the Thoroughfare Plan, or requiring subdividers to provide for the dedication and/or reservation of rights-of-way in advance of construction. These practices reduce the overall cost of the Plan by having some costs borne by developers. Recommended Subdivision Ordinances are included in Appendix A.

Functional designs are designs of a proposed roadway which are preliminary in nature, and not to the level of detail of construction plans. They may show only the centerline of the proposed roadway, or the edge of pavement and right-of-way. A functional design should be based on engineering principals, with consideration to the topography, property lines, and a screening of environmental factors. A functional design can be very useful when applying subdivision regulations to provide for proposed facilities shown on the Thoroughfare Plan. In the absence of a functional design, local staff must be diligent in plan review to assure the concept of the Thoroughfare Plan is adhered to.

The Town may develop their own functional design, have one done by a consultant, or let developers provide one on a piecemeal basis. Upon request of the local jurisdiction, NCDOT may provide functional designs for major thoroughfares in areas which are under development pressures. The current time frame for providing a functional design through the State is six months to a year.

Should it be desired that NCDOT provide a functional design for a specific facility, the Town Manager or Council should make a written request to the Statewide Planning coordinator for the area. The coordinator will then work with NCDOT Roadway Design and the Town. The Town may be asked to provide mapping, information on properties and other data. Once the functional design is completed, it will be turned over to the Town for their implementation purposes.

Zoning

Zoning is probably the single most commonly used legal device available for implementing a community's land-use plan. A zoning ordinance can be beneficial to thoroughfare planning in that planned locations of various land uses and planned densities of dwellings can be realized. This provides a degree of stability on which to make future traffic projections and to plan streets and highways.

Other benefits of a good zoning ordinance are: (1) the establishment of standards of development which will aid traffic operations on major thoroughfares, and (2) the minimization of strip commercial development which creates traffic friction and increases the traffic accident potential. The zoning ordinance should be structured to control strip development along the major traffic-carrying thoroughfares.

The zoning ordinance does not regulate the design of streets, utilities, the dedication of parks, school sites, and related matters. These are typically controlled by subdivision regulations. The zoning ordinance should be carefully coordinated with subdivision regulations and other control measures.

Official Street Map

The roadway corridor official map (or official map) is a document, adopted by the legislative body of the community, that pinpoints and preserves the location of proposed streets against encroachment. In effect, the official map serves notice on developers that the State or municipality intends to acquire certain specific property. The official map serves as a positive influence for sound development by reserving sites for public improvements in anticipation of actual need.

The NCDOT limits its use of official maps to large scale, fully access controlled facilities planned for developing areas outside of municipal jurisdictions. For projects within municipal jurisdictions, official maps should be prepared and adopted by the local government. Municipalities may adopt official maps that extend beyond its extraterritorial jurisdiction with approval from the Board of County Commissioners.

It should be recognized that an official map places severe but temporary restrictions on private property. These restrictions are in the form of a prohibition, for up to three years, on the issuance of building permits or the approval of subdivisions on property lying within an official map alignment. The three year reservation period begins with the request for development approval. This authority should be used carefully and only in cases where less restrictive powers are found to be ineffective.

Requests for NCDOT to prepare and adopt an official map should be directed to the Manager of the Program and Policy Branch. For cities contemplating the adoption of an official map, there are two ways in which the City may proceed. The first is to consider the official map statute as a stand-alone authority and use it as the basis for local adoption of an official map. Alternatively, the second approach is to adopt a local ordinance modeled after the statute, but modified to fit local circumstances and clarify the statute. Regardless of the approach taken, several procedural steps will need to be considered, such as establishing procedures for consideration of variance petitions.

Once the project has been selected and the alignment determined, maps must be prepared that are suitable for filing with the County Register of Deeds Office. The map should show the proposed alignment in sufficient detail to identify the functional design and the preliminary right-of-way boundaries. Since the purpose of the map is to show the effect on properties along the project path, the existing property boundaries should be identified. Within one year of the adoption of an official map, work must begin on an environmental study or preliminary engineering.

It is important to recognize the risks inherent in the adoption of an official map prior to completing the environmental studies. Projects to be funded using any federal funds require the unbiased evaluation of alternative alignments. This means that other alternatives will be studied and compared to the protected alignment. [1]

The above information serves as an introduction to official maps, and in no way provides the information necessary to begin development of an official map. The Program and Policy Branch of the North Carolina Department of Transportation is responsible for facilitating the adoption of Official Street Maps.

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[1] "Guidelines for Municipalities Considering Adoption of Roadway Corridor Official Maps", prepared by NCDOT Program and Policy Branch. Towns considering Official Street Map projects should contact this Branch for their "Guidelines for Municipalities Considering Adoption of Roadway Corridor Official Maps" at:

Programming and Policy Branch
NC Department of Transportation
P.O. Box 25201
Raleigh, North Carolina 27611

TABLE 9

IMPLEMENTATION POSSIBILITIES

CORRIDOR Section	FUNCT'NL CLASS	CONSTRUCT NC & FED	OFFICIAL MAP	LOCAL PROGRAMS AND ORDINANCES				
				URBAN RENEWAL	SUBDIV REGS	CAPITAL IMPROV'	LOCAL BOND	ADVANCE ROW
PRIORITY GROUP 1								
EASTERN WAKE EXPRESSWAY								
Buffaloe to US 64	PA-NHS	X	X		X			X
EASTERN WAKE EXPRESSWAY								
US 64 to US 64 Bypass	-	X	X		X			X
US 64 BYPASS								
I-440 to US 64/264	PA-NHS*	X	X		X			X
PRIORITY GROUP 2								
Buffaloe Road (SR 2215)								
Old Milburnie Rd-Marks Creek Rd	MinC	X			X			X
Marks Creek Rd. - Rolesville Rd	-	X			X			X
Forestville Road (SR 2049)								
Old Knight Rd - s. Old Milburnie	L	X			X		X	
Hodge Road (SR 2516)								
US 64 Byp. - US 64	MinC	X			X			
Lynnwood Drive (SR 2619)								
Lynnwood - Hodge Road	L					X	X	
McKnight / Laurens Way Connector	-				X	X	X	
Poole Road (SR 1007)								
Hodge Road - Bethlehem Road	MajC	X			X			
Rolesville Road (SR 1003)								
US 64 - Buffaloe Extension	MajC	X			X			X
Smithfield Road (SR 2233)								
Broadway - Bethlehem Road	MinC	X		X	X	X	X	
Bethlehem Rd. - US 64	MinC	X		X	X	X	X	
US 64 - Forestville Road	L	X			X	X	X	

*Congressional High Priority Corridor

				LOCAL PROGRAMS AND ORDINANCES				
CORRIDOR Section	FED AID SYSTEM	CONSTRUCT NC & FED	OFFICIAL MAP	URBAN RENEWAL	SUBDIV REGS	CAPITAL IMPROV'	LOCAL BOND	ADVANCE ROW
PRIORITY GROUP 2 cont.								
US 64								
Hodge Road - US 64 Business	PA-NHS	X			X			
Eastern Wake Expressway crossovers	-				X	X	X	
PRIORITY GROUP 3								
Bethlehem Rd (SR 2049)/First Ave								
Poole Rd - Old Faison Road	MinC	X			X			
Old Faison Rd. - Smithfield Rd	MinC	X		X	X		X	
Pine St. - US 64	MinC	X			X		X	
Hodge Road (SR 2516)								
Poole Rd. - US 64 Bypass	MinC	X			X			
Mailman Road (SR 2513)								
Fayetteville Rd. - Robertson St	L	X			X		X	
Old Faison Road (SR 2515)								
Hodge Rd. - Bethlehem Road	L	X			X		X	
Old Ferrel Road (SR 2512)								
Bethlehem Rd. - Smithfield Rd	L				X		X	
Poole Road (SR 1007)								
Bethlehem Rd. - Smithfield Road	MajC	X			X			
Puryear Road (SR 2235)								
Marks Creek Rd. - Rolesville Rd	L	X			X			
Clifton / Old Milburnie Connector	-				X	X	X	
Faison / Forestville Loop								
Old Faison Rd. - Smithfield Rd.	L	X			X		X	
Fayetteville Rd. - Old Knight Rd	L	X			X		X	
McKnight / Old Crews Connector	-				X	X	X	

PA-NHS - Principal Arterial - also on National Highway System
PA - Principal Arterial
MajC - Major Collector
MinC - Minor Collector
L - Local system

Urban Renewal

Urban renewal plays a minor role in the transportation planning implementation process. However, under the right circumstances, renewal programs can make significant contributions. Provisions of the New Housing Act of 1974 (as amended) call for the conservation of good areas, rehabilitation of declining areas, and clearance of slum areas. In the course of renewal, it is important to coordinate with the Thoroughfare Plan to see if additional set-backs or rights-of-way are needed.

Continued use of urban renewal programs to improve the transportation system is encouraged. Every effort should be made to ensure that community development and transportation plans are compatible.

Capital Improvements Program

One of the tools which makes it easier to build a planned thoroughfare system is a capital improvements program. This is a long range plan for the spending of money on street improvements, acquisition of rights-of-way, and other capital improvements within the bounds of projected revenues. Municipal funds should be available for construction of street improvements which are a municipal responsibility, right-of-way cost sharing on facilities designated as a Division of Highways responsibility, and advance purchase of right of way where such action is required.

Historically cities and towns have depended, to a great degree, on Federal or State funding to solve their transportation problems. Chapter 136-Article 3A of the Road and Highway Laws of North Carolina outlines the responsibilities of governmental bodies regarding highway improvements. North Carolina Highway Bill 1211, passed in 1988, limits the role of municipalities to specific limits in right-of-way cost sharing. Set-back regulations, right-of-way dedications and reservations play a major role in the ultimate cost of many facilities.

Street Line Ordinance

A municipality may, through special enabling legislation, adopt an official street map which indicates both existing and proposed future street lines. No new construction or reconstruction of structures would be permitted within the designated future street lines. This would, over a period of time, reduce the cost of additional right-of-way along densely developed thoroughfares which require widening and minimize damage to adjacent properties.

Table 9 represents the implementation possibilities for Priority Groups 1 through 3 of the proposals resulting from the Thoroughfare Plan Study. This section will briefly highlight how the controls and tools could be utilized on specific projects.

Summary

The goal in preparing this report was to help decision makers focus on, and take advantage of opportunities to exercise the available tools to develop the transportation system for the Knightdale Planning Area.

No single control or tool discussed is adequate to serve the transportation implementation function in and of itself. Since transportation serves development, development decisions should consider the impact that they will have on the transportation system. Lead planning time and land acquisition often requires many years before construction can begin. The existence of a Thoroughfare Plan, and use of the tools discussed in this report will allow a timely response to development.

APPENDICES

APPENDIX A

RECOMMENDED SUBDIVISION ORDINANCES

rev. 6/91,K93

DEFINITIONS:

I. Streets and Roads:

A. Urban Streets

1. Major Thoroughfares - Major thoroughfares consist of Inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

2. Minor Thoroughfares - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thorough-fare system by facilitating minor through-traffic movements and may also serve abutting property.

3. Local Street - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

B. Specific Type Rural or Urban Streets

1. Freeway, expressway, or parkway - Divided multilane road-ways designed to carry large volumes of traffic at high speeds. A freeway provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An expressway is a facility with full or partial control of access and generally with grade separations at major inter-sections. A parkway is a for non-commercial traffic, with full of partial control or access.

2. Residential Collector Street - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

3. Local Residential Street - Cul-de-sacs, loop streets less than 2,500 feet in length, or streets less than one mile in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

4. Cul-de-sac - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.

5. Frontage Road - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.

6. Alley - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

II. Property

A. Building Setback Line - A line parallel to the street in front of which no structure shall be erected.

B. Easement - A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

C. Lot - A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

III. Subdivision

A. Subdivider - Any person, firm, corporation or official agent thereof, who subdivides of develops any land deemed to be a subdivision.

B. Subdivision - All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets; provided, however, that the following shall not be included within this definition nor subject to these regulations: (1) the combination or recombination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein; (2) the division of land into parcels greater than ten acres where no street right-of-way dedication is involved, (3) widening of opening of streets; (4) the division of a tract in single ownership whose entire area is no greater than two acres into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

C. Dedication - A gift, by the owner, of his property to another party without any consideration being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.

D. Reservation - Reservation of land does not involve any trans-fer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

DESIGN STANDARDS

I. Streets and Roads

The design of all roads within the Town of Knightdale shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted by the Knightdale Board of Commissioners.

The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

A. Right-of- way Widths - Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where ROW requirements have been specifically set out the Thoroughfare Plan and accompanying technical report.

a.	Major Thoroughfare other than Freeway and Expressway	70 ft.
b.	Minor Thoroughfare	70 ft.
c.	Local Street	50 - 60 ft.
d.	Cul-de-sac	Variable**

The subdivider will only be required to dedicate a maximum of 120 feet of right-of-way. In cases where over 100 feet of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 120 feet. On all cases in which right-of-way is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width right-of-way, not less than sixty feet in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is sub-divided, the remainder of the full required right-of-way shall be dedicated.

** The ROW dimension will depend on radius used for vehicular turnaround. Distance from edge of pavement of turnaround to ROW should not be less than distance from edge of pavement to ROW on street approaching turnaround.

B. Street Widths - Widths for street and road classifications other than local shall be as recommended by the Thoroughfare Plan and subdivision regulations. Width of local roads and streets shall be as follows:

1. Local Residential
   Curb and Gutter section: 26 feet, face to face of curb
   Shoulder section: 20 feet to edge of pavement plus 4 foot shoulders
2. Residential Collector
   Curb and Gutter section: 35 feet, face to face of curb
   Shoulder section: 22 feet to edge of pavement, 6 foot shoulders

C. Geometric Characteristics - The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-Way shall apply.

1. Design Speed - The design speed for a roadway should be a minimum of 5 mph greater than the posted speed limit. The design speeds for subdivision type streets shall be:

DESIGN SPEEDS

Facility Type	Design Speed Desirable	Minimum Level	Rolling
URBAN			
Major Thoroughfares other than Freeway or Expressway	60	50	50
Minor Thoroughfares	60	50	40
Local Streets	40	40**	30**

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* Based on projected annual average daily traffic of 400-750. In cases where road will serve a limited area and small number of dwelling units, minimum design speeds can be reduced further.

** Based on projected annual average daily traffic of 50-250.

2. Maximum and Minimum Grades

a. The maximum grades in percent shall be:

MAXIMUM VERTICAL GRADE		
	Terrain	
Design Speed	Level	Rolling
60	4	5
50	5	6
40	6	7
30		9

b. Minimum grade should not be less than 0.5% .

c. Grades for 100 feet each way from intersections (measured from edge of pavement) should not exceed 5%.

d. For streets and roads with projected annual average daily traffic less than 250, short grades less than 500 feet long, may be 150% of the value in the above table.

3. Minimum Sight Distance - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the following parameters:

SIGHT DISTANCE				
Design Speed	30	40	50	60
Stopping Sight Distance				
Minimum (ft.)	200	275	400	525
Desirable Minimum (ft.)	200	325	475	650
Minimum K* Value for:				
Crest curve	30	80	160	310
Sag curve	40	70	110	160

(General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case.)

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* K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length in feet of the vertical curve which will provide the desired sight distance.

Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1984".

4. The "Superelevation Table" below shows the maximum degree of curve and related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter of 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.08, with 0.04 being desirable in the Central Business District.

SUPERELEVATION TABLE

Design Speed	Maximum e*	Minimum Radius ft.	Max. Deg. of Curve.
30	0.04	302	19 00′
40	0.04	573	10 00′
50	0.04	955	6 00′
60	0.04	1,528	3 45′
30	0.06	273	21 00′
40	0.06	509	11 15′
50	0.06	849	6 45′
60	0.06	1,380	4 15′
30	0.08	252	22 45′
40	0.08	468	12 15′
50	0.08	764	7 30′
60	0.08	1,206	4 45′

e* = rate of roadway superelevation, foot per foot

D. Intersections

1. Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than seventy-five (75) degrees.

2. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

3. Off-set intersections are to be avoided. Intersections which cannot be aligned should be separated by a minimum length of 200 feet between survey centerlines.

E. Cul-de-sacs

Cul-de-sacs shall not be more than five hundred (500) feet in length. The distance from the edge of pavement on the vehicular turnaround to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turnaround. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

F. Alleys

1. Alleys may be required to serve lots used for commercial and industrial purposes.

2. The width of an alley shall be at least twenty (20) feet.

3. Deadend alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turnaround facilities at the deadend as may be required by the Planning Board.

G. Permits For Connection To State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any con-struction on the street or road. The application is available at the office of the District Engineer of the Division of Highways.

H. Offsets To Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 30 feet from the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 6 feet from the face of curb.

I. Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersect-ions where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

J. Horizontal Width on Bridge Deck

1. The clear roadway widths for new and reconstructed bridges

serving 2 lane, 2 way traffic should be as follows:

a. Shoulder section approach

i. Under 800 ADT design year

Minimum 28 feet width face to face of parapets of rails or pavement width plus 10 feet, whichever is greater.

ii. 800 - 2000 ADT design year

Minimum 34 feet width face to face of parapets of rails or pavement width plus 12 feet, whichever is greater.

iii. Over 2000 ADT design year

Minimum width of 40 feet, desirable width of 44 feet width face to face of parapets or rails.

b. Curbs and gutter approach

i. Under 800 ADT design year

Minimum 24 feet face to face of curbs.

ii. Over 800 ADT design year

Width of approach pavement measured face to face of curbs.

Where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face of curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be 1'6" minimum, or greater if sidewalks are required.

2. The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

a. Shoulder section approach - Width of approach pavement plus width of usable shoulders on the approach left and right. (Shoulder width 8' minimum, 10' desirable.)

b. Curb and gutter approach - Width of approach pavement measured face to face of curbs.

APPENDIX B

STREET TABULATION

The Street Tabulation consists of an alphabetized street listing, with base year and future year traffic, and the recommended cross section for each street. Proposed facilities follow the listing of existing roadways.

Where information is not otherwise available, information may be taken from the most appropriate mapping.

Definitions

Practical Capacity: Capacity at Level of Service D
1991/92 ADT: Average daily traffic in 1991 or 1992
2010 ADT: Average daily traffic (2010)

3 ln	Three lane roadway
4 dv	Four lane divided roadway
2 lnp	Two lane roadway plus parking lane(s)
adeq	Adequate
N/A	Not applicable
-	Information not available
4 dv-S	Four lane divided roadway, staged construction. Initially two lanes on multi-lane right-of-way.

Street - . Section Reference	LENGTH (mi.)	EXISTING ROADWAY (ft)	EXIST. ROW	PRACT. CAPACITY	1991/92 ADT	2010 ADT	RECOMMENDED CROSS-SECTION	
							ROADWAY	ROW
Bethlehem Rd (SR 2049)/First Ave								
Poole Rd - US 64 Bypass	0.77	18 (2 ln)	-	9,000	2,700	7,300	I (3 ln)	60
US 64 Byp - Faison Road	0.85	18 (2 ln)	-	9,000	2,700	7,500	I (3 ln)	60
Old Faison Rd. - Smithfield Rd	0.93	18 (2 ln)	-	9,000	4,500	7,700	I (3 ln)	60
Smithfield Rd. - Pine Street	0.41	38 (2 lnp)	-	8,000	4,100	7,500	I (3 lnp)	100
Pine St. - US 64	0.52	24 (2 ln)	-	13,000	4,100	7,500	I (3 ln)	60
Buffaloe Road (SR 2215)								
Old Milburnie Rd-Marks Creek Rd	3.20	18 (2 ln)	-	9,000	3,300	10,000	G (4 dv)	120
Marks Creek Rd. - Rolesville Rd	0.58	N/A	N/A	N/A	N/A	6,000	G (4 dv)	120
Clifton Road (SR 2601)								
Poole Rd. - Faison Rd	1.60	20 (2 ln)	60	10,000	-	-	L (2 ln)	70
Faison Dr./ Harper Road								
Smithfield Rd. - Hester St	0.16	20 (2 ln)	-	8,000	-	-	L (2ln)	60
Fayetteville Road (SR 2513)								
First St. - Broadway	0.47	20 (2 ln)	60	10,000	1,300	2,000	L (2 ln)	adeq
Broadway - Mailman Road	0.90	20 (2 ln)	60	10,000	350	700	L (2 ln)	adeq
Forestville Road (SR 2049)								
Old Knight Rd - s. Old Milburnie	2.50	19 (2 ln)	-	9,000	1,900	12,600	I (3 ln)	90
s. Old Milburnie - Eastern Wake Exp	-	see Skycrest Drive						
s. Old Milburnie - Buffaloe Rd	1.65	19 (2 ln)	-	9,000	2,400	3,500	L (2 ln)	70
Hester Street								
Harper Rd. - Robertson St	0.22	20 (2 ln)	30	8,000	-	-	L (2 ln)	60

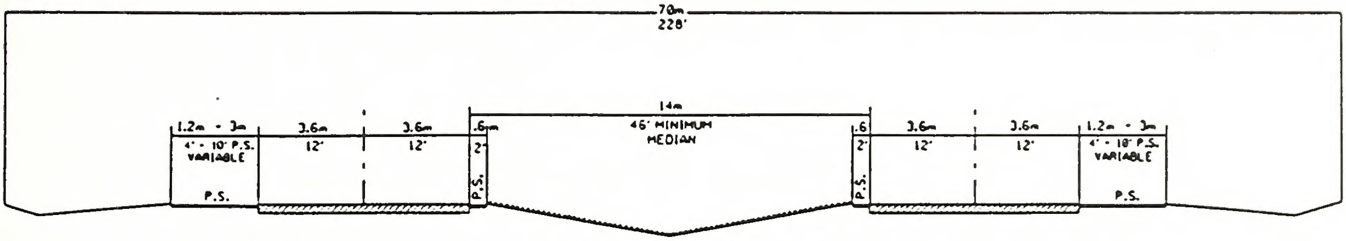
Street - . Section Reference	LENGTH (mi.)	EXISTING ROADWAY (ft)	EXIST. ROW	PRACT. CAPACITY	1991/92 ADT	2010 ADT	RECOMMENDED CROSS-SECTION	
							ROADWAY	ROW
Hodge Road (SR 2516)								
Poole Rd. - US 64 Bypass	1.08	20 (2 ln)	-	10,000	3,700	5,500	H (4 ln)	70
US 64 Byp. - US 64	2.14	20 (2 ln)	-	10,000	4,900	9,900	H (4 ln)	70
Horton Road (SR 2231)								
Forestville Rd. - Buffaloe Rd	2.33	18 (2 ln)	60	7,000	1,400	3,000	L (2 ln)	70
Lynnwood Drive (SR 2619)								
US 64 - Lynnwood	1.25	35 (2 ln)	70	13,000	-	-	adeq	adeq
Lynnwood - Hodge Road	0.28	18 (2 ln)	60	9,000	-	-	I (3 ln)	adeq
Mailman Road (SR 2513)								
Smithfield Rd - Fayetteville Rd	0.99	20 (2 ln)	60	10,000	600	1,500	L (2 ln)	70
Fayetteville Rd. - Robertson St	0.44	N/A	N/A	N/A	N/A	1,800	I (3 ln)	70
Maple Street								
Smithfield Rd. - First St	0.13	20 (2 ln)	-	8,000	-	-	L (2 ln)	60
Marks Creek Road (SR 2500/SR 2234)								
Robertson Rd. - US 64	1.37	18 (2 ln)	-	9,000	-	-	L (2 ln)	70
US 64 - Buffaloe/Jones Chapel	1.76	18 (2 ln)	-	9,000	1,700	4,000	L (2 ln)	70
Massey Farm Road / Marshall Drive								
First St. - Marks Creek Road	1.25	18 (dirt)	-	5,000	-	-	L (2 ln)	70
McKnight Drive								
US 64 - Smithfield Road	0.68	35 (2 ln)	60	13,000	-	-	adeq	adeq
Old Crews Road (SR 2228)								
Forestville Rd. - Buffaloe Road	1.93	20 (2 ln)	60	10,000	150	500	L (2 ln)	70
Old Faison Road (SR 2515)								
Hodge Rd. - Bethlehem Road	1.99	20 (2 ln)	60	10,000	2,200	4,000	G (4 dv-S)	100

Street - . Section Reference	LENGTH (mi.)	EXISTING ROADWAY (ft)	EXIST. ROW	PRACT. CAPACITY	1991/92 ADT	2010 ADT	RECOMMENDED CROSS-SECTION	
							ROADWAY	ROW
Old Ferrel Road (SR 2512)								
Bethlehem Rd. - Smithfield Rd	1.06	20 (2 ln)	60	10,000	500	1,300	I (3ln)	60
Old Knight Rd (SR 2232)								
US 64 - Horton Road	1.80	18 (2 ln)	60	9,000	2,200	4,000	L (2 ln)	70
Pine Street								
First St. - Fourth Street	0.21	19 (2 ln)	66	8,000	-	-	L (2 ln)	adeq
Fourth St. - McKnight Drive	0.25	N/A	N/A	N/A	N/A	-	L (2 ln)	60
Poole Road (SR 1007)								
Hodge Road - Bethlehem Road	1.96	22 (2 ln)	-	11,000	8,100	15,000	D (5 ln)	90
Bethlehem Rd. - Smithfield Road	2.10	22 (2 ln)	-	11,000	4,500	8,000	D (5 ln)	90
Puryear Road (SR 2235)								
Marks Creek Rd. - Rolesville Rd	1.08	20 (2 ln)	-	10,000	180	500	L (2 ln)	70
Robertson St (SR 2500) / Knightdale-Eagle Rock Road								
First Street - Marks Creek Rd	1.15	18 (2 ln)	-	8,000	1,300	2,200	L (2 ln)	70
Marks Creek Rd. - US 64 Bypass	1.34	18 (2 ln)	-	9,000	400	800	L (2 ln)	70
Rolesville Road (SR 1003)								
US 64 - Buffaloe Extension	1.85	20 (2 ln)	-	10,000	2,100	10,100	G (4 dv)	120
Smithfield Road (SR 2233)								
Poole Rd. - Broadway	3.03	18 (2 ln)	60	9,000	1,500	3,000	L (2 ln)	70
Broadway - Bethlehem Road	0.53	18 (2 ln)	60	8,000	4,100	10,400	D (5 ln)	90
Bethlehem Rd. - US 64	0.80	18 (2 ln)	60	9,000	7,400	17,000	D (5 ln)	90
US 64 - Forestville Road	0.74	18 (2 ln)	60	9,000	2,200	8,000	I (3 ln)	70
Third Avenue								
Smithfield Rd. - Pine Street	0.29	19 (2 ln)	66	8,000	-	-	L (2 ln)	adeq
Pine St. - First Street	0.54	N/A	N/A	N/A	N/A	-	L (2 ln)	60

Street - . Section Reference	LENGTH (mi.)	EXISTING ROADWAY (ft)	EXIST. ROW	PRACT. CAPACITY	1991/92 ADT	2010 ADT	RECOMMENDED CROSS-SECTION	
							ROADWAY	ROW
US 64								
Hodge Road - US 64 Business	5.28	48 (4 dv)	350	34,900	35,200	41,700	M (6 dv)	adeq
PROPOSED FACILITIES								
Clifton / Old Milburnie Connector	4.10	N/A	N/A	N/A	N/A	-	G (4 dv-S)	100
Eastern Wake Expressway	N/A	N/A	N/A	N/A	N/A	49,900	N (4 dv)	300
Eastern Wake Expressway crossovers	1.0 each	N/A	N/A	N/A	N/A	-	I (3 ln)	70
Faison / Forestville Loop								
Old Faison Rd. - Smithfield Rd.	0.72	N/A	N/A	N/A	N/A	-	G (4 dv-S)	120
Smithfield Rd. - Fayetteville Rd.	0.20	20 (2 ln)	-	10,000	-	-	G (4 dv-S)	120
Fayetteville Rd. - Robertson St.	0.75	N/A	N/A	N/A	N/A	-	G (4 dv-S)	120
Robertson St. - Old Knight Road	1.19	N/A	N/A	N/A	N/A	-	G (4 dv-S)	120
McKnight / Old Crews Connector	N/A	N/A	N/A	N/A	N/A	-	I (3 ln)	60
McKnight / Laurens Way Connector	0.93	N/A	N/A	N/A	N/A	-	I (3 ln)	60
Skycrest Drive	N/A	N/A	N/A	N/A	N/A	15,300	H (4 ln)	70
US 64 Bypass	N/A	N/A	N/A	N/A	N/A	46,100	N (dv)	300

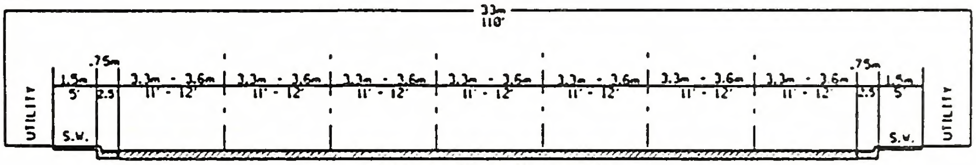
TYPICAL THOROUGHFARE CROSS SECTIONS

A.



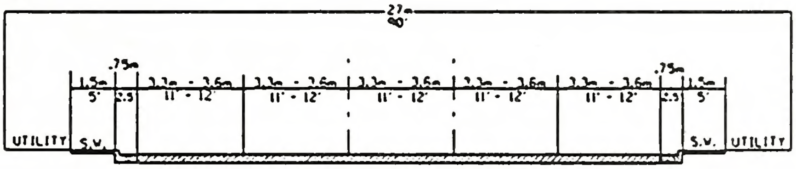
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



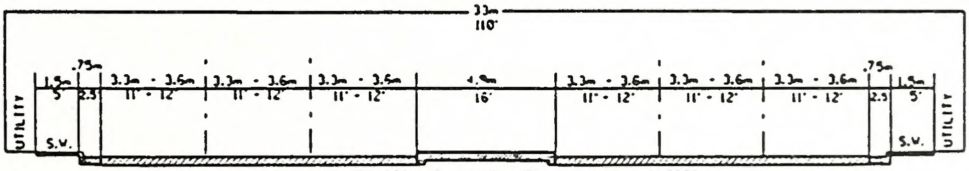
SEVEN LANES - CURB & GUTTER

C.



FIVE LANES - CURB & GUTTER

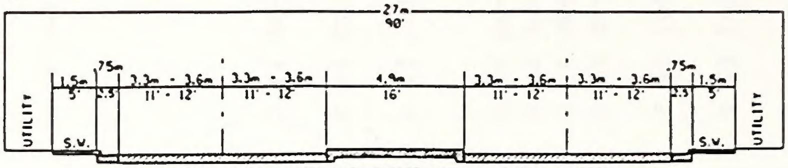
D.



SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

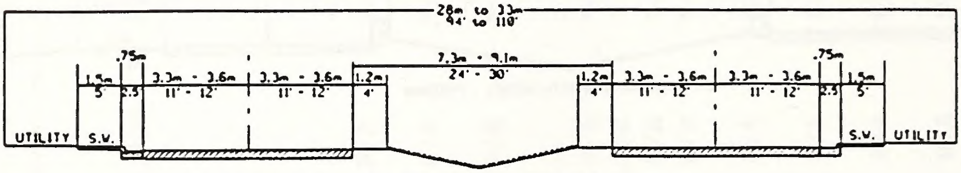
TYPICAL THOROUGHFARE CROSS SECTIONS

E.



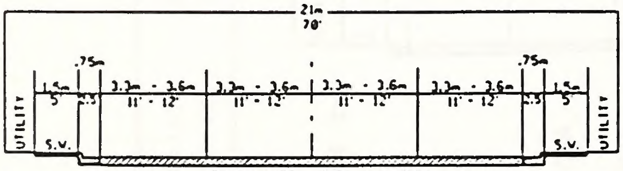
FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



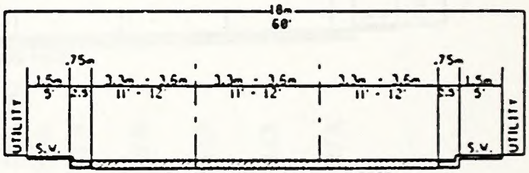
FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



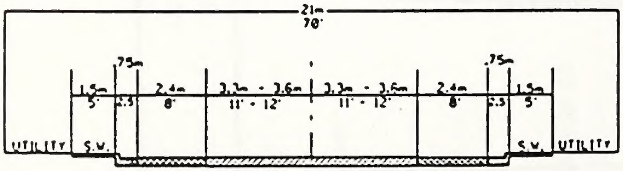
FOUR LANES - CURB & GUTTER

H.



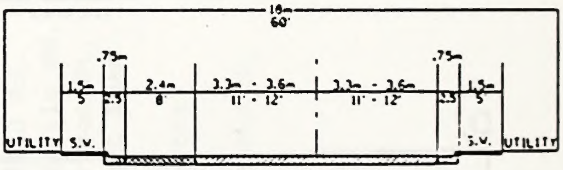
THREE LANES - CURB & GUTTER

I.



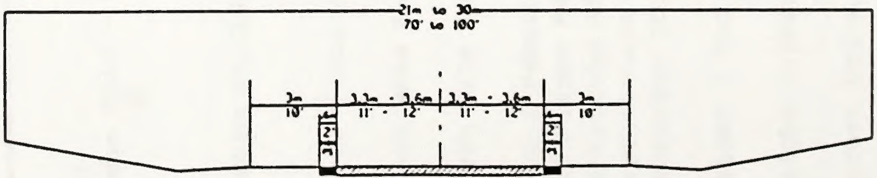
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.



TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

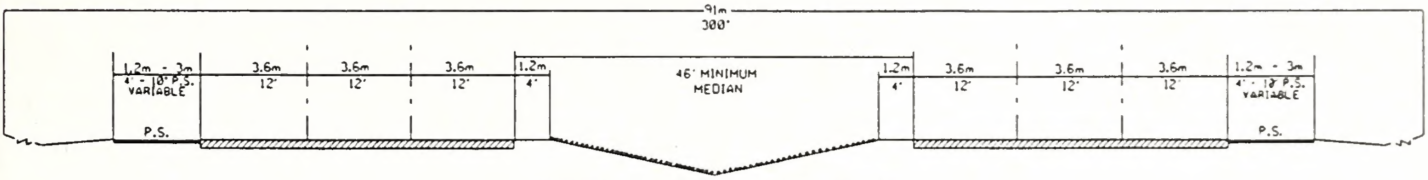
K.



TWO LANES - PAVED SHOULDER

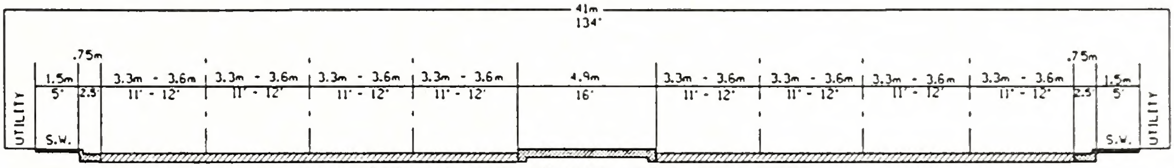
TYPICAL THOROUGHFARE CROSS SECTIONS

L.



SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

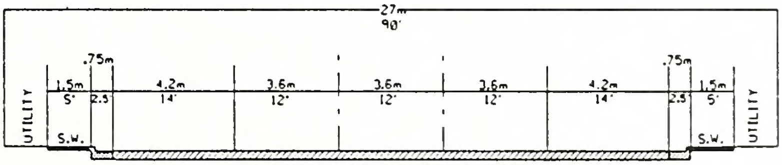
M.



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

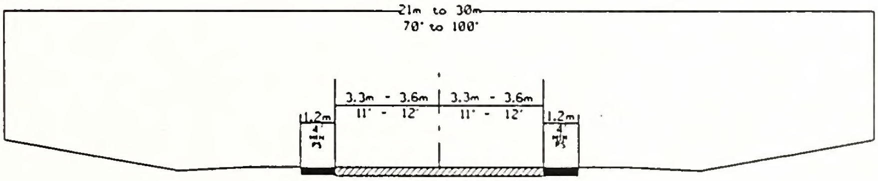
TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



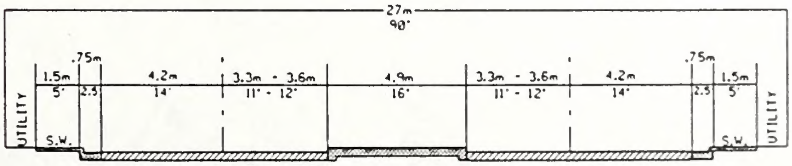
FIVE-LANE ROADWAY WITH CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

O.



TWO LANES - SHOULDER SECTION

P.



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

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